ARCHIVES OF OTOLOGY.

REPORT OF TWO CASES OF SINUS THROMBOSIS COMPLICATED BY CEREBRAL ABSCESS IN THE TEMPORO-SPHENOIDAL LOBES.

By Dr. WILLIAM R. DABNEY, Marietta, Ohio.

(With two charts on Text-Plate III.)

THE following cases are reported to illustrate not only the seriousness of delay of an operation when once the mastoid has become involved in a pyogenic process, but also to demonstrate what life-destroying complications may be going on in the brain and yet the patient be able to go about and attend to the duties associated with his avocation in life in a fairly intelligent manner.

When once the diagnosis of mastoid empyema is positive, there should be no delay in opening the mastoid cells and freeing them of the products of inflammation, as when the encephalon begins to disintegrate or an infected thrombus of a dural sinus develops, the hope of recovery is very meagre; and last but not least, if the pia mater or arachnoid should become the seat of a purulent inflammation, the prognosis is extremely grave, as the death-rate is practically 100%.

To those that are thoroughly familiar with mastoid surgery, mastoid empyema is regarded in the same light as is appendicitis by the abdominal surgeon when it has reached the stage of purulent effusion, and yet I have met men of undoubted ability in abdominal surgery who believe that appendicitis should be operated as soon

as the diagnosis is established and before pus has developed, in order to prevent a possible general peritonitis, but yet these same men in a case of mastoid empyema will advise delay or palliative measures without considering the fact that when once the leptomeninges, membranes that are infinitely more delicate than the peritoneum, become involved in a pyogenic inflammation as a complication of a purulent mastoiditis one can be prepared to fill out the death certificate at his leisure as in the vast majority of cases it is a question of a very short time until the patient makes an *exitus lethalis*.

CASE 1.—Male, age 48 years. This case came to my notice on Jany. 20, 1907.

HISTORY.—*Heredity:* Negative. *Personal:* Says that he had a severe cold about the middle of December and that he began to have pain in the left ear about four days after the onset of the cold. A discharge appeared from the ear on the second day after the pain began. The ear has discharged moderately since and there has been a continuous pain in the ear and mastoid, associated with more or less pain of the entire head. It was remarked by one of the gentleman's friends that he had seemed to be in a somewhat dazed condition for the past week, as he did not take his usual interest in affairs about the farm and his replies to questions were surly and grudgingly given, contrary to his usual straightforwardness.

Present Condition.—Patient is slow to comprehend what is said to him, as our questions have to be repeated several times before we are able to get a reply. Temp. 101° F. by mouth. Pulse 88. There is a thick blood-streaked discharge coming from the left ear. Smear taken and streptococci found. A perforation that is not large enough to admit of free drainage is seen in the anterior-inferior quadrant of the drum. There is slight sagging of the posterior-superior membranous canal. Tenderness on pressure over the tip and antrum is well marked and there is a fair amount of swelling of the soft tissues overlying the mastoid.

Percussion of this side of the head does not increase the general head pain nor cause pain to radiate from the point of

percussion over the head. Reflexes are normal; pupils are slightly dilated but react to light and accommodation.

OPHTHALMOSCOPIC EXAMINATION.—*Right Eye:* Negative. *Left Eye:* This eye is more sensitive to light than its fellow and the disk margins are rather indistinct.

Diagnosis.—Mastoiditis with possible intracranial complications. It was advised that the patient be kept under observation until the following morning before operating, but he insisted that the operation be done at once, and his friend agreed with him.

OPERATION.—*Anæsthetic:* Chloroform. Only a slight amount of yellow pus was encountered and that was in the antrum, but the tip cells were filled with a thin dark fluid. The trabeculæ were very much softened and masses of dark granulations were found in all the cells. The sulcus of the sigmoid sinus lay so far forward that the posterior canal wall had to be taken down before the antrum could be reached. The tympanic cavity was found full of dark granulation material like that encountered in the mastoid, and there was a perforating erosion of the roof of the tympanum through which dark granulations were protruding. These granulations were curetted and a possible perforation in the dura looked for but none was found

The patient did very well for forty-eight hours after operation, when the temperature reached 103° F. and the pulse 98. He was very restless and semi-delirious, but when questioned repeatedly he would reply briefly and slowly.

The dressing was taken down and the exposed dura showed signs of beginning ulceration, but there was no discernible perforation in the dura. The temperature dropped two degrees after the dressing, but the pulse became slightly accelerated.

On the following morning (the third day after the operation) the patient was perfectly conscious and the restlessness of the previous evening had disappeared. He expressed himself as feeling better than he had at any time since his sickness began. At this time there was a slight Babinski reflex and Kerning's sign was positive, the angle of extension being much less than 135° F.

Jany. 25th, the morning of the fifth day since the operation.

Temp. 100° F. Pulse 96. He could not be aroused sufficiently to answer questions, but would swallow water when it was placed in his mouth. There was a motor paralysis of the entire right side of his body, the different members of which became paralyzed simultaneously. Both pupils are moderately dilated and they react very sluggishly to light. There is a choked disk to the extent of five dioptres in the left eye.

A diagnosis of brain abscess was made, but as the patient's wife had returned to her home in the country it was several hours before her consent for a second operation could be obtained.

It was thought that there was a purulent meningitis present as there was some rigidity of the posterior cervical tissues and the head was retracted; there had been a number of well marked clonic contractions of different members of the body. He was wildly delirious at times and it was with the greatest difficulty that he could be restrained sufficiently to keep him in bed.

As the motor paralysis of the face, arm, and leg had appeared simultaneously without a coincident sensory paralysis it was thought that the cerebral abscess was located above and external to the internal capsule, being situated most probably in the region of the lenticular nucleus where the motor tracts cross.

Under chloroform anæsthesia the perforation in the roof of the tympanum was enlarged sufficiently to admit of a free incision of the dura. The incision in the dura was started at the point where an ulceration had been previously noted and was carried outward and backward along the floor of the middle fossa. A curved grooved director was introduced upward and inward into the brain for a distance of one and one-fourth inches, when about two drams of foul-smelling pus was evacuated. This pus contained streptococci.

Owing to the irregular and rapid interruptions in the temperature curve and the slight chilly sensations that were complained of at times by the patient, it was thought that we might have to deal with a complicating sinus thrombosis; accordingly the sinus was exposed and an aspirating needle of large size was pushed through the outer wall of the sigmoid sinus and a free flow of blood at once followed, but when

pressure was applied above the needle the flow of blood immediately ceased. As the patient was sinking rapidly under the anæsthetic it was not deemed prudent to investigate the sinus farther at this time.

Jany. 26th.—Morning after the secondary operation and sixth day after the primary operation. At my visit this morning I found that the patient had some use of his right arm and leg, and he seemed to be conscious, as he made an effort to reply to questions, although his replies could not be understood as he could not articulate distinctly.

During the late afternoon of this date the patient became unconscious and had convulsive seizures which were repeated at frequent intervals during the night.

Our patient died at 10 o'clock the following morning without regaining consciousness. An autopsy was not permitted.

CASE 2.—White male, age 15 years. I first saw this patient at 8 P. M. Sept. 7, 1904, in consultation with Dr. C. M. Boger of Parkersburg, W. Va.

History.—Heredity—nothing that would influence the present trouble. Personal—was struck on the right side of the head with a stone about one year ago with sufficient force to render him unconscious for a short time. Has had a number of attacks of purulent otitis in the right ear which is the seat of the present disturbance. Present illness began ten days ago, which was three days after the patient had been bathing in one of the mountain streams of Colorado.

Present Condition.—Temp. 103° F. Pulse 48. Resp. 26.

The patient had the appearance of one suffering from a general septicæmia; there were jaundice and constipation; the entire body bathed in a cold clammy sweat; the breath foul, and the tongue, which was deeply furrowed, was plastered over with a dark brown coat. His voice was tremulous and his speech hesitating. There was œdema over the mastoid and the ear was tilted well forward.

The pain that he complains of is referred to both the ear and the mastoid. The slightest pressure applied over the antrum and mastoid tip causes excruciating pain.

There is a copious flow of sanguinolent pus from the external auditory canal. The external ear and canal were cleansed and a fair-sized perforation could be seen in the lower

anterior quadrant of the drum. The inner end of the superior-posterior membranous canal is boggy and sagging. A smear was taken from the pus as it came through the perforation in the drum and was found to contain streptococci and what were thought to be the diplococci of Weichselbaum.

When the patient assumes a vertical position subjective vertigo is complained of. He says that the whole right side of his head aches quite severely, and when this side of the head is percussed the pain radiates over the entire head. There is a dull aching pain in the right eye accompanied by hyperæmia of the conjunctiva and photophobia. Ophthalmoscopic examination of this eye shows a well defined papillitis.

Diagnosis.—A positive diagnosis of mastoiditis was given, and on account of the low pulse and high temperature provisions were made in the diagnosis for the possible complications of brain abscess and purulent meningitis.

For twenty-four hours previous to the time that I saw this patient an aural ice-bag had been applied over the mastoid without the slightest amelioration of the symptoms, and as we did not deem it advisable or prudent to further prolong the abortive plan of treatment we urged an immediate operation, but we were met by a request to wait until the following morning as the relatives of the boy could not bring themselves to believe that he was in a very serious condition.

Sept. 8th, 3 A. M.—Temp. 97.4° F. Pulse 43.

He was very restless during the night and had a slight chill at midnight. His replies this morning were quick and intelligent, and he seemed so much better that he was allowed by his family to get up and dress and go to a hospital in an open buggy.

The family were still reluctant to have an operation, but after being apprised that they would have to assume the entire responsibility if this procedure was longer deferred, their consent for an operation was very hesitatingly given and it was intimated that if the case terminated fatally under our manipulations it might be a question of "Pistols for two, and coffee for one," as they were from Colorado.

Operation.—The outer cortex was only of moderate thickness and pus followed the removal of the first chip of bone. The entire cellular structure of the mastoid was found to be

filled with the products of inflammation. A mass was found in the antrum and the chloroform test showed it to be pure cholesteatoma. An erosion was seen in the roof of the antrum through which granulation tissue was pouting and a few drops of pus could be seen exuding from this granulating mass.

While curetting the fistulous opening in the lamina vitrea the curette entered a small perforation in the dura mater and a slight amount of pus escaped when the curette was withdrawn. It was the intention of the operator to explore the brain in this locality but not in so precipitate a manner. The perforation in the dura was enlarged sufficiently to allow us to inspect the brain and an area of necrotic brain tissue about the size of a large hazel-nut was found.

The margins of the dural incision were held apart with small retractors and a layer of granulations and thick bloody pus could be seen on the inner surface of the dura. The pus in the subdural space was mopped with tufts of cotton wrung out in physiologic salt solution, and the necrotic brain tissue was scooped out and a wick of gauze wrapped in guttapercha tissue was used as a drain. The mastoid wound was packed with strips of iodoform gauze.

Sept. 10*th*, 6 P. M.—During the past twenty-four hours the patient has had two chills and perspired quite freely. There have been several abrupt and rapid interruptions in the temperature curve and the pulse has had a wide range. The temperature has been as low as 100° F. and as high as 105° F. during this time, and the pulse has been from 50 to 106 per minute.

The neck has become very tender and œdematous along the course of the internal jugular vein, and the lymphatics of this region are enlarged and sensitive. The boy has developed a cough which is accompanied by a slight prune-juice expectoration and large moist râles are heard on auscultation.

A sigmoid sinus thrombosis was suspected and the patient was taken to the operating room and chloroform administered at 8 P. M. of this date. Owing to the symptoms of metastasis that were already manifested, a primary resection of the internal jugular vein was at once resorted to, the vein was resected from beneath the clavicle to its exit from the skull. The sinus was then uncovered backward from the knee for

three-fourths of an inch, and downward below the level of the digastric fossa, but a palpable clot could not be detected.

The parietal wall of the sinus was thickened and covered with a layer of plastic lymph. We were prepared to open the sinus, but at this juncture the anæsthetist announced that the patient was failing rapidly, and the operation was discontinued without opening the sinus, but a strip of gauze was hurriedly packed against the exposed wall of the sinus and under the margins of the bone wound with sufficient firmness to preclude the passage of blood through the sinus and to obstruct the mouths of the vessels that are tributary to the sinus in its vertical and horizontal portions, and also to prevent particles of a possible septic thrombus from entering the general circulation through the torcular end of the sinus.

Sept. 14th.—For the past two days the boy has been perfectly rational at times, and at other times he has had an almost maniacal delirium, swearing at the nurses and members of his family, and it required the combined efforts of several persons to restrain him in bed. There is a convergent strabismus of the right eye and the pupils of both eyes are moderately dilated and sluggish to light and accommodation; the skin is flushed and tache cerebrale can be demonstrated. There is some rigidity of the neck and the head is slightly retracted. He cannot move the left arm and it is only after stimulation by repeated requests that he is able to move the left leg. The skin is hypersensitive at points, while at other points there is cutaneous sensory anæsthesia to pressure, but he complains of an intense itching and pricking of the skin. When conversing he now and then drops a syllable from his words and the elided syllable may be from any part of the word if it be a word of more than one syllable. During his lucid periods he says that he is conscious of this defect in his speech but that it is impossible for him to avoid it. When writing from dictation he transposes the words of the sentence so that they are rendered meaningless or the sense is entirely changed. He is unable to designate common objects by their proper names, as he calls an apple a ball. As you will note, he retains the sense for form but not for names. Ankle clonus is noticeable on the right side, and Kerning's, Strumpell's, and Babinski's signs are positive.

Sept. 16th, 5 P. M.—There is complete motor paralysis of the left leg and arm; ankle clonus is highly manifested in the left limb and to a slight extent in the right one; he is very irritable and replies very slowly or not at all when questioned. He has been constipated for several days but has not vomited although he has had considerable nausea.

For the past twenty-four hours the temperature has not been above 102° F. nor below 100° F., while the pulse variations have been from 45 to 56 per minute.

On account of the paralysis and the continued low pulse-rate it was thought that another abscess was developing in the brain.

The patient was anæsthetized at 8 P. M. of the above date, and an attempt was made to open the skull over the arm and leg centres on the right side, but when the diploic structure was reached the hemorrhage was so profuse that it was not checked until wooden plugs were driven into the diploic sinuses, and as the patient was not taking the anæsthetic kindly all operative procedures had to be abandoned for the time.

Sept. 17th, 8 A. M.—The patient is resting easier this morning, and after being repeatedly asked to do so he is able to move the left leg slightly and he can exert some slight pressure with the left hand. When questioned his replies are more quickly given and his attention can be longer sustained than it could yesterday.

Sept. 18th, 8 A. M.—The patient's mental condition is not so good this morning, and there is a complete motor paralysis of the left arm and leg, the angle of the mouth droops slightly, and the left eye does not close perfectly.

It was again decided to make an attempt to reach the abscess in the brain as we could not believe that the extensive paralysis was due to the purulent meningitis that was present in the case. The patient was anæsthetized and the primary mastoid wound was enlarged upward and forward for three-fourths of an inch above the temporal ridge. The dura was incised and a slender bistoury was carried upward and inward into the brain until the abscess was reached when a quantity of sanguinolent pus escaped. I will not attempt to estimate the amount of pus that was set free as it might lead you to

think that I have macropsia. The sinus was opened at this sitting and a small elastic clot was found low down near the jugular bulb.

From the time of the opening of the second abscess in the brain the recovery of the patient was uneventful and he returned to his home in Colorado in ten weeks from the date of the primary operation.

The symptoms that were manifested in this case and the location of the lesion were somewhat at variance. The zone of language is said by authorities to be located in the cortex of the left temporo-sphenoidal lobe in a right-handed, and *vice versa* in a left-handed, person. This young man is right-handed and he is not ambidextrous; the brain abscess in this case, as you will remember, was located in the right temporo-sphenoidal lobe.

I do not think that there can be the slightest doubt as to the presence of a purulent meningitis as a complication in this case, as pus was found in the subdural space at the primary operation, and that a diffuse leptomeningitis was subsequently developed was amply demonstrated by the symptoms that supervened, as there were areas of thoracic and abdominal pain, as well as areas of cutaneous sensory anæsthesia at different levels of the cord.

The aphasic symptoms may have been due to an extension of the purulent meningitis to the opposite side of the head. If this were the case and the pressure was great enough to cause the aphasic manifestations, would it not have been possible for the confined exudate to have produced a motor paralysis of the right side of the body? Or could a cerebritis that was consequent to a purulent meningitis be responsible for the aphasia without the encephalitis being extensive enough to affect the motor area? If the aphasia was due to the meningitis, or cerebritis, and not to the brain abscesses, why did the pressure symptoms subside almost immediately after the second abscess in the brain was drained?

There was one symptom in this case that I did not al-

CASE 1.

TEMPERATURE (FAHR.)
PULSE
HOURS OF DAY
DAY OF MONTH
Jan. 20
21
22
23
24
25
26
27
ON ADMISSION
AFTER OPERATION
WOUND DRESSED
WOUND DRESSED
WOUND DRESSED
AFTER OPERATION
DIED AT 10 A.M.

CASE 2.

TEMPERATURE (FAHR.)
PULSE
HOURS OF DAY
DAY OF MONTH
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
WHEN BRAIN EXPOSED
DURING OPERATION
ASSISTANT'S FINGER IN OPERATION
OPERATION ATTEMPTED OPEN BRAIN ABSCESS
OPERATION BRAIN ABSCESS EVACUATED SUPERIOR SINUS OPENED

lude to in the early part of this paper as all of my notes of the case were not at hand at the time it was written. The symptom which I refer to is one that is quite diagnostic of brain abscess when it occurs early and is manifested on the opposite side of the body to that of the brain abscess. The symptom which I point to is the rapid wasting and emaciation of the palsied side of the body in contradistinction to the slower wasting and emaciation that is seen in a hemiplegia that is due to a cerebral embolism.

I may be justly or unjustly criticised for not investigating the sinus at the time of the primary operation, but the boy had had only one chill and it could have been accounted for by the acute brain abscess that was developing, or the purulent meningitis might have been responsible for the rigor.

The bacteriological and pathological examination of the excised jugular vein demonstrated a septic thrombophlebitis, as streptococci were found in the walls of the vessel and infected parietal thrombi were discovered adherent to the intima almost as far down as the site of the lowermost ligature, and a pure culture of streptococci was grown from these thrombi.

From the information that was gained from the above examination I think that we were amply justified in doing a primary jugular resection, if the symptoms had not warranted such a procedure. As septic parietal thrombi were found so low down in the vein, one can readily see that simple ligation of the vessel high up in the neck would not have been radical enough to have brought about the termination of the septicæmia and pyæmia which occurred so soon after the vein was resected.

A CASE OF ACUTE INTERNAL HYDROCEPHALUS SECONDARY TO STREPTOCOCCAL INFECTION OF THE LABYRINTH.

By SYDNEY R. SCOTT, M.S. London, F.R.C.S. England,

CHIEF ASSISTANT AURAL DEPARTMENT, ST. BARTHOLOMEW'S HOSPITAL; AURAL SURGEON, EVELINA HOSPITAL FOR SICK CHILDREN.

THE following case is described:

1. On account of its comparative rarity.

2. Because it throws light on the early diagnosis of labyrinthine infections.

3. For the reason that an operation on the labyrinth would probably have saved the patient's life had the true state of affairs been realized in time.

4. Inasmuch as it was possible to demonstrate post-mortem the precise connection between the labyrinthine mischief and the attendant hydrocephalus.

Joseph O'Grady, age 14, a schoolboy, was admitted to St. Bartholomew's Hospital, 1st March, 1907, under the care of Mr. Cumberbatch, to undergo the radical mastoid operation for chronic otorrhœa. The patient had been attending the Aural Out-patient Department for nearly six months, without making any signs of progress towards recovery.

The tympanic cavity was full of granulations which obscured all normal landmarks. There was no mastoid swelling or tenderness.

Mentally he was very backward, so that the tests for hearing were unreliable.

He was evidently very deaf in the left ear, but whether there was perosseous loss could not be ascertained. He made no complaint of giddiness and there was no facial paralysis. Past lesions had led to the removal of one eyeball and dense corneal opacities in the other.

During the four days he was in the hospital before the operation his general health was good; he was up and out of doors daily; he slept and ate well.

Operation.—On the 5th March, 1907, during Mr. Cumberbatch's temporary absence, I performed the radical mastoid operation on the left side.

The lateral sinus was very large and occupied an unusually anterior position, reaching to the posterior wall of the external auditory canal; the blue color of the sinus-contents could be plainly seen through the bone, after reflection of the integuments and periosteum.

The antrum was small and deep, and lay in a plane posterior to the prominent genu of the sinus.

The floor of the middle cranial fossa bulged down, and overhung the antrum externally.

To obtain freer access to the antrum, the genu of the lateral sinus was freely exposed and displaced backwards. In doing this, the sinus was unintentionally opened.

After controlling the bleeding, the antrum and attic were opened and the radical operation completed in the usual way. The dura of the middle fossa where it overhung the antrum was exposed, otherwise there was nothing further requiring special mention. The inner tympanic wall was carefully inspected, but not explored with a probe. The external arcuate eminence, the Fallopian aqueduct, the promontory of the cochlea, and the entrance to the Eustachian tube were all recognizable. The niche between the promontory and the aqueduct, in which the stapes normally lies concealed, was occupied by granulations, to remove which a specially small curette, which might have entered the vestibule, was used.

Both large ossicles had completely disappeared.

A meato-conchal flap was turned upwards and the cavity filled with gauze. The post-aural wound was sutured and dry dressings applied in the usual way.

Subsequent Course.—The patient passed rather restless nights and vomited every day for five days—although there was no change in the pulse or temperature and the wound was free from secondary inflammation.

On the 5th day he began to complain of headache, and on the 6th day the vomiting ceased.

Nothing could be found to account for these untoward symptoms. There was no loss of consciousness, no delirium, no retraction of the head, and no change in the pulse or temperature.

On the 8th day the pain in the head was very severe, and the patient lay with his head between his hands, half buried in the bedclothes. He did not cry out, and remained perfectly conscious.

The temperature, which had been rising for two days, was now 102°; the pulse between 84 and 100.

Otherwise no sign of value could be found to throw light on the case. The knee-jerks were equal and not exaggerated and there was no tremor or paralysis. The plantar reflex was flexor in the right foot, and a single doubtful extensor response was obtained in the left foot.

An examination of the fundus oculi was precluded by reason of the corneal opacities.

The original wound was re-opened, the middle and posterior cranial fossæ were explored by free removal of bone upwards and backwards from the mastoid. No extradural abscess could be found. The dura, which appeared perfectly healthy, was not opened. There was no fistula leading into the external semicircular canal, and nothing to account for the pain could be discovered.

This exploration failed to indicate the cause of the patient's condition; it was therefore resolved to wait for further developments and for time to collect additional clinical data—the results of lumbar puncture and of the blood examination.

These examinations were unfortunately deferred until too late, for he died next day.

A few minutes before death, he complained to his foster-mother, who sat beside his bed, of "feeling very bad in the head," and when she rose to leave him he was dead. The

heart as well as the respiration had given out, and artificial respiration was of no avail.

I made the post-mortem examination 20 hours after death, and I think the findings sufficiently important to be given in detail although this involves some repetition.

REPORT OF POST-MORTEM, MARCH 14, 1907.

Nature of Disease.—Chronic suppurative otitis media. Left side. Recent radical mastoid operation. Obliteration of the lateral sinus. Acute streptococcal labyrinthitis: perineuritis, 7th and 8th cranial nerves. (Ependymitis)—Secondary internal hydrocephalus.

DETAILS.

External.—The body was that of a moderately nourished, normally developed boy. The right eyeball was missing. In the left eyeball there was a leucoma of the cornea, with anterior synechia.

Ear, Left Side.—Behind the pinna were two wounds: (1) semilunar, over the mastoid; (2) horizontal, from the middle of the first wound towards the external occipital protuberance.

The Method of Removal of the Brain.—The cranial vault was sawn through in the supraorbital horizontal plane,[1] and the skull-cap removed; the dura and brain were then incised in situ in the same plane; the brain above this section was replaced within the cranial vault, where it was preserved intact in formalin.

The lower half of the brain was removed in sections in situ from above downward. This method enabled one to see the exact state of affairs in the posterior cranial fossa.

The Method of Examination of the Temporal Bone.—After removing the brain and reflecting the dura, the labyrinth was opened with the gouge, first the superior canal, then the vestibule, and then the cochlea. The temporal bone was afterwards detached and preserved in formalin.

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[1] *Journal of Anatomy and Physiology*, 1905. "Topography of the Human Skull."

The Left Temporal Bone.—The middle ear cavity presented the usual appearance seen after the complete operation. The eminence of the external semicircular canal was free from caries. The superior semicircular canal was found to contain blood-stained fluid, and the membranous canal was very vascular and looked like a deep red filament. The vestibule contained turbid fluid: the fenestra ovalis was occupied by granulations which did not invade the cavity of the vestibule, although the foot-plate of the stapes had completely disappeared. In the larger coils of the cochlea the fluid was pale yellow, and at the apex the fluid was blood-stained. (The other canals were not opened in the fresh state.)

The fluid in different parts of the labyrinth was taken in a pipette as each cavity was opened, and afterwards examined bacteriologically by Mr. C. E. West, who found streptococci pyogenes in almost pure culture.

The Arachnoid.—In front of the anterior aspect of the left hemisphere of the cerebellum, the arachnoid tissue was distended with slightly turbid fluid, and formed a sac, somewhat hemispheric in shape, and about *3cms* in diameter. This cyst-like collection of fluid completely enveloped the intracranial part of the 7th and 8th cranial nerves, from the internal auditory canal to the cornucopia in the outer horn of the fourth ventricle of the brain.

The fluid was examined bacteriologically, but no growth was obtained on culture media.

The Dura Mater.—Below and behind the internal auditory meatus, were slender plastic adhesions on the cerebellar aspect, between the distended arachnoid and the adjacent dura. There was no extradural abscess and there was no evidence of infection by the ductus endolymphaticus. The lateral sinus was occluded by pressure with gauze. There was no evidence of sepsis.

Brain.—The surface of the cerebral hemispheres, vertical and basal, was singularly devoid of fluid in the arachnoid tissue of the sulci. The brain felt much firmer and more resistant to pressure than usual; this tenseness was evidently due to the accumulation of fluid within the ventricles, for when the horizontal section was made the fluid from the lateral ventricles escaped under high pressure, spurting out for a distance

of 12 inches, and the brain regained its normal consistence. The fluid was not quite clear but very slightly cloudy. The lateral ventricles were equally distended and held approximately 5 ounces, but some fluid was lost. The 3d or 4th ventricles had also evidently been distended, for they appeared abnormally dilated even after the fluid had escaped.

There was no occlusion of the Sylvian aqueduct and no abnormality of the veins of Galen or the foramen of Majendie.

REPORT ON THE BACTERIOLOGICAL EXAMINATION.

By Mr. C. E. West.

(1). Cerebro-spinal fluid from the descending horn of the lateral ventricles: no growth.

(2). Fluid from the arachnoid tissue no growth.

(3). Fluid from the vestibule: streptococcus pyogenes.

(4). Fluid from the cochlea: no growth.

Fluid in vestibule, 24 hours, agar tube: organisms morphologically and culturally resembling streptococci pyogenes with slight contamination.

Fluids 1, 2, and 4: no growth in 24 hours.

COMMENTS.

The foregoing is an account of a case of acute internal hydrocephalus, secondary to infection of the labyrinth, which set in after the radical mastoid operation had been performed for uncomplicated chronic suppuration of the middle ear.

The case throws light on the occurrence of acute internal hydrocephalus in the course of *otitis* media, even when this is unattended by gross complications, such as brain abscess or meningitis.

Clinically, previous to the operation the case presented no unusual features. Nothing was found or done at the operation to make one suspect a possible labyrinthine

infection. Clinical observations were curtailed by reason of the patient's defective sight and hearing, which accounted for his infirm mental capacity.

The first untoward symptom was vomiting; this occurred every day for five days after the operation.

The vomiting appears to have been produced by the infection of the labyrinth, although at the time nothing else confirmed this view. It is scarcely possible he could have been free from giddiness. Yet of this he made no complaint.

Severe headache afterwards masked all the symptoms, and was probably produced by the increasing distension of the ventricles of the brain.

The occurrence of sudden death in cases of hydrocephalus is of course well known, but in this case, without meningitis, it was unusually sudden and unexpected.

The autopsy was of special interest and emphasized the importance of the anatomical relations of the 7th and 8th cranial nerves.

The cornucopia of the choroid plexus in the fourth ventricle extends laterally, almost enveloping the medulla, and reaches as far forwards as the sides of the olivary bodies: it is at the lower border of the pons and close to the flocculus, where the 7th and 8th nerves emerge from the medulla, that the cornucopia of the choroid plexus is intimately related to the arachnoid sheath which surrounds the 7th and 8th nerves.

Along this sheath, the inflammation spread from the labyrinth to the ventricles of the brain.

Exactly how the labyrinth became infected at the operation was difficult to conceive, but the infection almost certainly spread from the tympanum to the vestibule through the fenestra ovalis.

It is unlikely that this infection was a mere coincidence, although the stapes had been apparently destroyed by granulations which may quite possibly have been disturbed although certainly not penetrated.

The occurrence of acute internal hydrocephalus as a terminal lesion in meningitis is so common that an account of an isolated case would be devoid of interest. The feature of this case is the absence of meningitis.

With the knowledge revealed by the autopsy a brief review of the symptoms and treatment may serve as an object-lesson.

The continuance of vomiting for several days after the radical mastoid operation for uncomplicated otitis media, and especially when followed by headache, will always suggest the possibility of labyrinthine infection.

In a patient capable of understanding what is required, the tuning-fork and co-ordination tests should be carefully observed.

When we know that no opening exists in the external semicircular canal, I think we should deliberately explore the fenestra ovalis and fossula rotunda with the probe.

If labyrinthitis is present, nothing short of extirpation of the cochlea and vestibule can be considered as likely to give efficient drainage.

Had the labyrinth been opened in the present case and effectively drained, and at the same time the distended ventricles been relieved by lumbar puncture, or puncture of the brain, it is almost certain life would have been saved.

NOTE.—I am indebted to Mr. Cumberbatch for permission to record this case. S. R. S.

A CASE OF MASTOIDITIS, WITH BRAIN COMPLICATIONS.

By FRANK KNAUSE, M. D.,

ASSISTANT SURGEON, MANHATTAN EYE AND EAR HOSPITAL.

(With Temperature Chart on Text-Plate IV. and Specimens of Handwriting on Text-Plate V.)

John Williams age 17 years, waiter by occupation was admitted to the Manhattan Eye and Ear Hospital April 1st.

Family history and past history negative. Patient on admission gave a history of earache on the left side. Duration about a week.

Physical examination showed usual signs of an acute otitis media and he had some tenderness over the antrum and tip.

Microscopical examination of a smear preparation of the discharge following myringotomy showed the presence of a diplo-bacillus. Four days after operation he developed an œdema extending backward toward the occipital region, the auricle protruded from the skull, and there was fluctuation above and behind the same.

Operation.—The first incision opened a **subperiosteal** abcess which was traced to a perforation in the region of the zygomatic cells. Another perforation was found over the tip. The mastoid was pneumatic in structure and cells were filled with pus. The bone covering the dura in the region of the antrum was necrosed and the dura exposed over this area. Usual mastoid operation was done.

On the second night after the operation, patient felt chilly and complained of severe pain in front of and above the ear. This pain was severe enough to keep him awake and he was extremely restless and delirious at times during the night. The next day, temperature was 103°; pulse 104; respiration 24.

There was rigidity of the posterior cervical muscles with tenderness over the same. He had a well-developed Kernig's sign; no Babinski; no ankle-clonus. No areas of anæsthesia. Reflexes (cremasteric) present. Pupils equal, react to light and accommodation. No ocular or other paralysis. Abdomen not retracted. No vomiting.

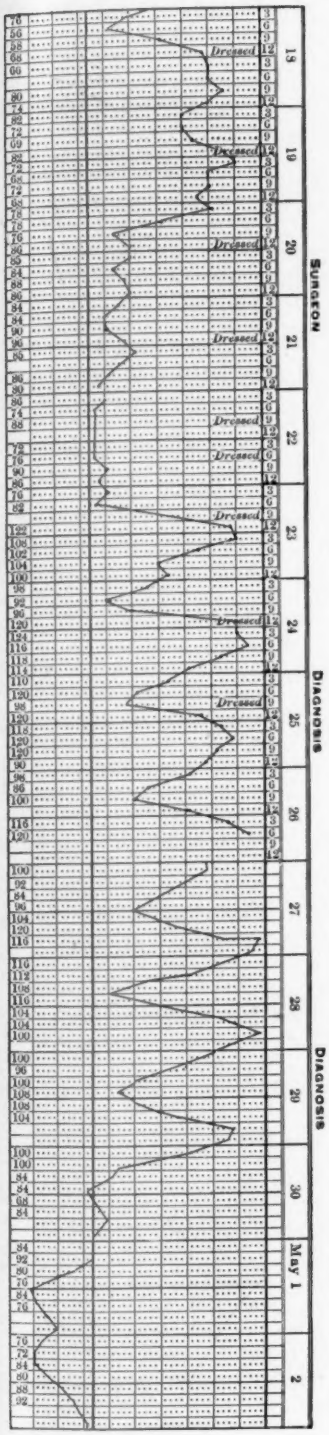
Examination of spinal fluid obtained by lumbar puncture shows slight turbidity and more polymorphonuclear cells than could be accounted for by the bleeding caused by the puncture. The fluid was not under increased pressure and no bacteria were present.

Examination of the eyes showed a beginning choked disk on the left side. Blood-count showed leucocytes, No. 7110, with 79% of polymorphonuclear cells. His mental condition was very interesting. His cerebration was slow but he did not seem delirious. Aphasia was present and limited to agraphia. He could not speak his name or call the name of such simple objects as knife, pencil, book, or coin when these were shown him. He instantly recognized the name when it was spoken and knew the uses of the different objects. He could not repeat the name after hearing it spoken. When asked to do so he would begin to count one, two, three; "one, two, three," and then say "I don't know." He indicated his desire for food or drink by pointing to his mouth. When asked to count fingers held before him he did so without difficulty. He also counted to twenty with but one mistake. He could mentally add and subtract. He could not, however, read either written or printed words, simple words like cat, pen, and knife. When asked his name he made an effort to speak it and then said, "I don't know." When shown his written name—John Williams—and asked what it was, he at once replied, "That 's my name." When asked again his name he was unable to give it. When asked a number of different names he was always able to indicate his own as soon as it was spoken. He was unable to tell the name of the city in which he lived, where he was born, or anything of his family. When asked to write his name he was able to write John but not his last. (See No. 1.)

This mental condition continued with slight increase of symptoms for six days. He was in a slight stupor from

which he was easily aroused. At night he was delirious frequently. He had involuntary micturition and defecation. The highest temperature during this time was 104°; highest pulse-rate 115. Examination of blood showed a leucocyte count of 12,000, with 67% polymorphonuclears. Fluid obtained by lumbar puncture came drop by drop through a fair-sized needle and was slightly turbid and again free from bacteria. The optic neuritis increased. He had no areas of anæsthesia. Temperature sense was lost over the whole body. Muscle sense was present and normal.

He complained of pain over the entire left side of the cranium and it was tender to the touch. On the 12th day of April, seven days after the first operation, at 9:30 A.M. he had an epistaxis, and at 10:30 A.M. a convulsion which was more tonic in character, with marked retraction of his head, and lasted about an hour. A partial facial paralysis of the right side of the face developed. The facial paralysis involved the lower branches only and he was able to close the eye on that side. The next day symptoms of increased pressure being shown by a subnormal temperature of 97.8° by rectum, pulse of 54, and respirations as low as 14, it was determined to explore him for the presence of a brain abscess. Under chloroform anæsthesia, an incision was carried forward from the upper end of the previous curvilinear incision for about 1¾ inches. Periosteum was retracted and the cortex was removed over the dura of the middle fossa, ¾ inch upward and 1½ inches forward. The wound was washed with saline solution and alcohol. Exploratory incision was made with a long flap knife forward and upwards, forward and downwards, forward and inwards, and inward anteriorly. Posteriorly, inward and forward and inward and upward; lastly, from a point corresponding to the antrum roof directly upward. No evidence of pus followed any of these punctures. The wound bled very freely, the bleeding being controlled by packing. This bleeding prevented us from seeing the appearance of the pia arachnoid membrane. The dura appeared normal except over roof of antrum, where necrotic bone had been removed at the first operation. No dural flap was made, but incision through the dura was made with one knife and the puncture with another to prevent infecting the brain as


No.
Name
April
Hour
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Dr. Atkinson
Dressed
Surgeon
Diagnosis
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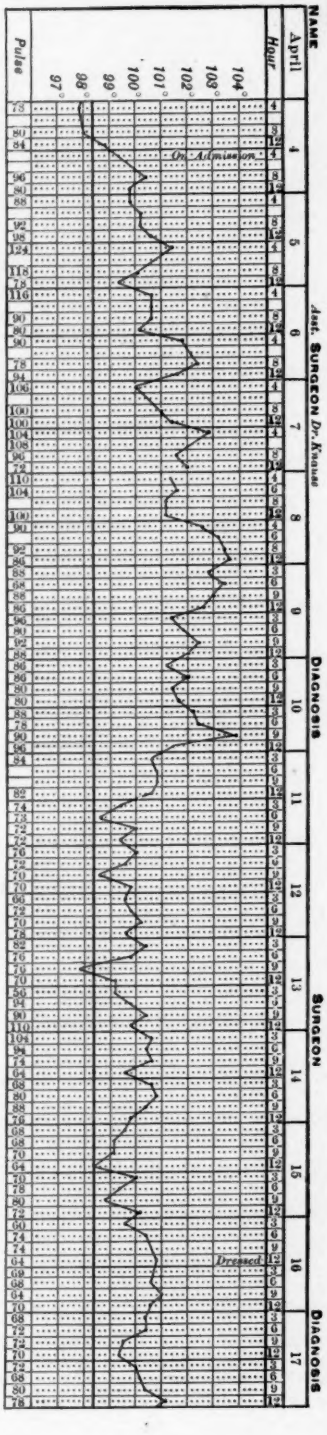
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Asst. Surgeon Dr. Knight
Dr. Atkinson
Dressed
Surgeon
Diagnosis

far as possible. There was no apparent increase in tension and no pulsation could be felt. The wound was left open, packed with iodoform gauze, and the patient returned to bed.

The next morning patient could tell his full name but could not tell the name of this city. He could not tell the largest city in England, could not speak the name knife, but instantly knew when the word was pronounced. Could protrude tongue for the first time. Facial paralysis unchanged. Pulse 84, full, regular. Mental condition improved.

April 15th: Aphasia much improved. Recognizes and gave the name of knife, his own name, told where he lived, and his folks. Could not tell his N. Y. address. Kernig's sign and rigidity of neck about the same. Facial paralysis improved. Wound showed marked œdema extending to some distance on the scalp tissues. (Middle ear was perfectly clean.) Writing showed improvement. (See No. 2).

April 16th: (Dressing done. Packing removed. Very slight bleeding. Wound healthy. No pus nor necrotic tissue. Dura not as yet showing granulations.) Patient fairly rational to-day, knows what is going on about him and asked nurse to return a pillow which had been borrowed from another patient, indicating to whom it belonged. The œdema increased to within an inch of the median line and from external occipital protuberance to external angle of orbit. Tender to touch. Eye-grounds apparently same.

April 18th: (Some secretion in the lower part of the mastoid wound. Dura covered with granulations. Dura over middle fossa bulging.) Fairly rational. Complains of pain over left side of his head, more marked at night. Writing now appeared normal. (See No. 3.)

April 19th: Wound clean. Mental condition not so good. Slow to comprehend.

April 20th: Condition about the same.

April 22d: Wound healthy. Granulations cover the entire wound. Rigidity of neck and Kernig's sign diminished. Aphasia much improved, but mental condition still dull. Facial paralysis completely gone.

April 23d: Wound clean. Œdema disappeared. Mental condition about the same. His temperature, which had been running about normal, rose to 104° and with diurnal remissions

of four or five degrees for four days,—the explanation being an erysipelas which ran its course in 14 days. Blood count at this time showed leucocytes 8440, with 70% polymorphonuclears. With the development of the erysipelas a marked change took place in his mental condition. Where before he had seemed under a cloud, now everything appeared clear mentally. He was able to converse, write his name, and read the paper fairly well. Certain words seemed to bother him, words of association such as bridge and river. He would spell either one properly, but would use bridge for river, or *vice versa*, when reading aloud from a paper, and be unaware of any error in doing so.

Patient was transferred to Bellevue Hospital where he remained for twelve days, being readmitted to the Manhattan Eye and Ear Hospital on May 7th. On readmission examination showed him to be perfectly normal as to mental condition. His memory was good and the agraphia and aphemia had disappeared. Reflexes were normal. He had no paralysis.

Examination of the left eye showed a normal retina; no remaining signs of an optic neuritis. Pupils equal in size, reacting both to light and accommodation. No oculomotor paralysis. He ate well, slept well, and was with difficulty prevented from wandering about the ward. He did not wish to stay in bed and was anxious to get back to work.

On May 20th, under chloroform anæsthesia, a plastic operation was done to correct the sagging of the auricle caused by the open treatment of the wound in the second operation, this wound having been packed instead of sutured. The result was that the erysipelas was lighted up and patient was again transferred to Bellevue for one day and then to the City Hospital. The second attack of erysipelas was of short duration and did not interfere with the healing of the plastic operation.

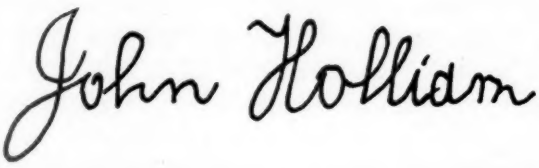
He was up about the ward, going out-of-doors and apparently convalescing satisfactorily when he suddenly died July 7, 1907.

Report of autopsy was as follows:

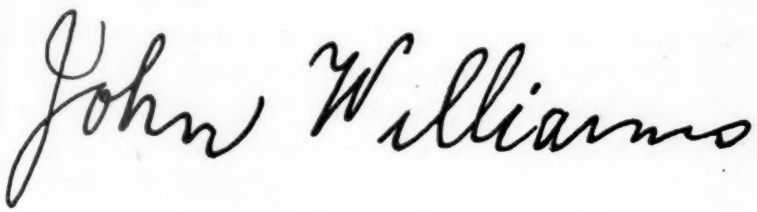
On removing calvarium the dura is very adherent to the left temporo-sphenoidal lobe. On removing the brain some

ILLUSTRATING DR. KNAUSE'S ARTICLE ON "A CASE OF MASTOIDITIS WITH BRAIN COMPLICATIONS."

NO. 1. APRIL 10, 1907. BEFORE EXPLORATION.



NO. 2. APRIL 14, 1907. TWO DAYS AFTER EXPLORATION.



NO. 3. APRIL 19, 1907.

of the substance comes away with the dura. Blood-vessels of the pia were markedly injected and were distended with dark fluid blood.

The left temporo-sphenoidal lobe is yellowish-green in color and very soft and mushy. On section there is a moderate amount of fluid in the lateral ventricles.

As we cut through the basal ganglia we see a large greenish-yellowish mass projecting upward. This mass seemed under a little tension and on turning the brain over it is seen to be the left temporo-sphenoidal lobe. On section of this mass about one half ounce of thick greenish pus escapes. This leaves a large cavity with large thick walls. The whole abscess-cavity seems to be walled off from the surrounding brain substance.

The spinal cord was normal. Additional lesions were: Acute, parenchymatous degeneration of the heart; acute miliary tuberculosis of the lungs; acute tubercular splenitis; acute parenchymatous nephritis with a small amount of interstitial nephritis; fatty cirrhosis of the liver.

The immediate cause of death was undoubtedly the cardiac lesion. The outline of the abscess corresponded with the kidney-shaped portion of the bone which had been removed from the skull, and the external wall of the abscess was not more than ¼ to ½ inch in thickness.

The convolution of Broca showed no macroscopial changes.

Some of the interesting features of the case are:

(1) Was the abscess of the brain present at the time of exploration?

(2) Were the symptoms due to a localized meningitis and the abscess the result of our exploratory operation?

(3) That while he had aphemia and agraphia there was no difficulty as to his perception of numbers.

(4) The rapid disappearance of symptoms following the local bloodletting.

REPORT OF A CASE OF MENINGITIS OF OTITIC ORIGIN; OPERATION; RECOVERY.

By PHILIP D. KERRISON, M.D.,

CLINICAL LECTURER ON DISEASES OF THE EAR, UNIVERSITY-BELLEVUE MEDICAL COLLEGE, NEW YORK

Mr. C., 34 years of age, was first seen by me on June 5, 1907, in consultation with Dr. Bruce Phillips.

The previous history is that of a discharge from the left ear, constant, scanty, offensive, which dates back to, and has persisted since, early childhood. For some years, the discharge has rarely been sufficiently profuse to cause great discomfort, and the patient has learned to cleanse the ear by wiping it out daily with sterile cotton wound about a wooden applicator.

I am indebted to Dr. Phillips for the following history of the onset of present attack. On Monday, June 3, 1907, the patient developed severe left earache,—so severe that he was directed to go to bed, and frequent hot irrigation of the ear was advised. On the following day, Tuesday, the earache was less severe, and toward evening was so far relieved that the patient, who is a lecturer in one of the Universities, got out of bed and attempted to look over some examination papers. On the following morning (Wednesday) Dr. Phillips was again called to find the patient obviously seriously ill. The chief symptoms at this time were fever, severe occipital headaches, and frequent vomiting. It was at 2 o'clock on this, the third day of the attack, that I was called in. He was vomiting when I arrived; his face was pale, cool and clammy, and drawn into an expression of pain. Rectal

temperature however registered 103°. Pulse 120 and rather thready. Pupils somewhat contracted but reacted to light. Mental condition dull, in that questions put in an ordinary conversational tone were answered without understanding or not at all. But by asking a simple and direct question in rather loud and insistent tones he could be aroused to answer intelligently. Thus to the question where he felt pain, he repeatedly and definitely located this in the back of his head.

Examinations of the Ears.—Right ear normal. Left ear, membrana tensa practically destroyed, tympanum containing granulations and a small amount of offensive pus.

Blood count by Dr. Sondern showed a leucocyte count of 22,800, and a polymorpho-nucleophile count of 88 per cent.

Patient was removed the same afternoon to the Manhattan Eye, Ear, and Throat Hospital. On admission at 4 P.M. the temperature had fallen to 101°, rising two hours later to 102°. Pulse 126. Patient practically unconscious,—*i.e.* it was no longer possible to communicate with him. Pupils very much contracted, so that Dr. Van Fleet found it impossible to examine the eyes until the local effect of belladonna had been obtained. No ocular changes were found present. Rigidity of the muscles of the back of the neck was now unmistakable. Other muscles not rigid. Reflexes not noticeably increased. Patient's condition now more nearly approached coma, in that though restless he was apparently oblivious to everything occurring about him. Dr. Whiting, in consultation, confirmed the diagnosis of cerebral meningitis and informed the patient's family that in his opinion the only chance of recovery lay in immediate operation. In this opinion Dr. Van Fleet and Dr. Bruce Phillips, his physician, concurred.

The question of lumbar puncture was discussed and was advised against on three grounds, viz: (1) that the diagnosis seemed clear without it; (2) that the disease was of too recent development for probable changes in the spinal fluid; and (3) that the procedure constituted a possible additional strain upon the patient and seemed to offer no positive therapeutic advantage.

Operation.—Usual post-auricular incision. This later was

augmented by a second incision commencing near the upper end of the first, and curving first upward and backward and then forward so as to form a flap, deflection of which exposed the outer wall of the mid-cranial fossa. Mastoid of sclerotic variety,—apparently eburneated throughout. Antrum deeply seated, small, and found to contain thick, creamy, ill-smelling pus. No perforation of tegmen antri demonstrable. Roof of antrum removed with chisel. Beginning from this point, the squama covering the temporo-sphenoidal lobe was next removed over a space extending from before backward about three inches.

Appearance of Dura.—Removal of bone here caused the dura to bulge considerably, showing decided increase in cerebral pressure. No pus between bone and dura was present, and no exudate was noticeable. Dura was congested, surface vessels being apparently engorged, and a few small areas of capillary injection being present. The dura was now opened by three parallel, vertical incisions about one inch in length and one inch apart. Considerable oozing of cerebral fluid followed. A grooved director was now introduced into the lower end of the anterior incision and carried directly into the substance of the brain for about two inches. The director was then withdrawn and introduced successively through the lower ends of the middle and posterior incisions. In the last situation the director was carried inward and somewhat backward to a depth of about 2 ¾ inches, and was followed by a considerable flow—not a gush—of cerebral fluid. The director was next introduced in exactly the same way through the upper ends of the three incisions, making six perforations of the brain in all. *This completed the operation.*

No attempt was made to introduce a drain of any kind into the brain or into the dural openings. Loose sterile gauze was placed in contact with the exposed dura, this being covered by a large sterile absorbent dressing.

On the following morning the patient's condition was as follows: Temperature at 9 A.M. 98.6°, pulse 78. The dressing and part of the pillow case were saturated with cerebral fluid. The patient was exceedingly restless and complained of severe headache. The mental condition, however, was clear. Asked if he felt better than the night before, he replied

promptly and positively that he did not;—that on the previous evening he had been "sitting up and examining students' papers," showing that his stay in the hospital previous to the operation represented a blank in his experience. Toward evening the condition again became somewhat alarming. The temperature rose to 102.8.° He complained of unbearable pain in the back of the head and along the spine, and his restlessness was such that the nurses had difficulty in keeping him in bed. This condition was controlled by morphine. The following morning found the patient more comfortable, and from this time there were no symptoms which seemed especially alarming. During the following ten days there were regular evening rises of temperature, which then reached and kept the normal line.

The progress of wound repair was watched with care as furnishing a possible indication for the final closing of the wound. By the end of the first week granulations were forming along the lines of the dural incisions, and soon covered the whole dural surface. The loss of cerebro-spinal fluid, however, continued long after the dural incisions were hidden from view. While this persisted the wound was kept open by interposing pads of gauze between the dural and the under surface of the flap. The wound was finally apposed and sutured on July 15th, about six weeks after the operation.

To me this case has been instructive chiefly in suggesting the following facts bearing upon the management of such cases:

(1) That drainage of the subdural spaces may be obtained by simple dural incision, and does not require the introduction of wicks or artificial drains of any kind.

(2) That by the method followed in this case drainage of the lateral ventricle may be established without subjecting the brain or meninges to any injury likely to result in cerebral herniæ, or subsequent cerebral or meningeal infection.

(3) That following such an operation the wound exposing the dura should not be allowed to close until

the loss of cerebral fluid has practically ceased. Such delay not only insures against sudden increase in cerebral pressure, but provides a barrier to cerebral infection in the protecting layer of firm granulations which has formed.

NOTE.—Among the symptoms one would expect in meningeal disease in which both cerebral and spinal meninges are involved, and which were absent in this case, are strabismus, general muscular rigidity, Kernig's symptom. I am inclined to believe that had we waited another twenty-four hours, one or more of these symptoms might have been added, and that the diagnosis might have been further sustained by the death of the patient.

THE "PIANO-STRING" THEORY OF THE BASILAR MEMBRANE.

By W. SOHIER BRYANT, A.M., M.D., New York.

IS the basilar membrane so constructed that its fibres can vibrate sympathetically to all the tones within the limits of hearing?

If the fibres of the basilar membrane are to vibrate sympathetically to all tones within the limits of hearing, two things must be true of them: (1) There must be enough of them. (2) Their lengths, tensions, and mass must be such that some of the different fibres must be capable of from 12 to 25,000 double vibrations per second. (These are the limits of audition.)

First, as regards the number of fibres in the basilar membrane: The maximum number which has been estimated is 24,000.[1] Preyer says: "Musicians can distinguish with certainty a difference of pitch arising from one half vibration per second in the doubly accentuated octave." If this is the case, there must be at least one fibre that vibrates, say 256 times per second, and another that vibrates 256½ times per second.

Assuming that this is true only within the limits of the musical scale (about 24 to 3000 whole vibrations per second), and allowing one fibre for each half vibration within these limits, and a single fibre for each whole vibration beyond these limits (*i.e.* from 12 to 24 and from

[1] Hensen and C. Hasse. Quoted by the author in Burnett's *System*, p. 72. Also Retzius.

3000 to 25,000 whole vibrations), there should be about 28,000 fibres. But since in the region of the highest tones probably no person can distinguish a difference of pitch of even a whole vibration, this number is undoubtedly considerably greater than the actual number of fibres necessary; and hence it corresponds closely enough to the estimated number of fibres (24,000) to make the theory of the sympathetic vibration of the basilar membrane plausible.[1]

But an investigation of the other conditions must be made before accepting the theory. That is, we must find out whether the lengths, tensions, and mass of the fibres are such that the different fibres may make from 12 to 25,000 whole vibrations per second. When a string is fastened at both ends and made to vibrate, the number of vibrations which it makes per second depends upon the length, tension, and mass per unit length of the string, the exact relation being expressed by the formula:

$$n = \frac{1}{2L}\sqrt{\frac{T}{m}}$$

where n is the number of vibrations per second; L, the length of the string; T, its tension; and m, the mass per unit length. In our problem, n varies from 12 to 25,000, and the length of the fibres in the basilar membrane, (that is L) varies from .041*mm* near the lower extremity to .495*mm* at the apex.[2] Substituting these extreme values in the formula and assuming that the tension is uniform throughout the whole membrane, we can find what relation must exist between the mass per unit length of the first and last fibres of the membrane. This relation is about 1: 30,276 ! On the other hand, if we assume that the mass per unit length is the same in all the fibres,

[1] A. DENKER, "Die Membrana Basilaris im Papageien-Ohr und die Helmholz'sche Resonanztheorie." *Festchr. J. Rosenthal*, Leipzig, 1906, i., pp. 277-285.

[2] HENSEN and C. HASSE. Quoted by the author in BURNETT'S *System*, p. 91.

then the relation between the extreme tensions must be 1: 30,276! And finally, if both the mass and the tension vary, then the products of the extreme values of both must be in the ratio of 1: 30,276! All of these conclusions are not only improbable but impossible, and hence the theory of the sympathetic vibration of the basilar membrane will not stand under close analysis.

A further objection to the "piano-string" theory is that the basilar fibres cannot fulfil the requirement of a resonating body on account of the load of tissue attached to them, and further there are several layers of fibres running in different directions in the membrane as shown by H. Ayres.[1] Shambaugh[2] has shown that the organ of Corti in the pig's ear exists independent of both the basilar fibres and basilar membrane.

The above physical conditions seem to negative the Helmholtz "piano-string" theory. Shambaugh's theory of the sympathetic vibration of the fibres of the tectorial membrane is physically impossible, because the structure of the membrane would preclude any sympathetic vibration to many tones. These deductions make it most probable that the sensitive hair theory which I am investigating may prove to be the true theory.

CONCLUSIONS: 1. The *basilar membrane is not essential to the organ of Corti, and, when present, is not furnished with the requisite length and mass of fibres to vibrate in sympathy with every note even if the rest of the structures would allow it.*

2. *Further the basilar membrane is devoid of the requirements of a resonating body.*

3. HELMHOLTZ'S *"piano-string" theory of musical preception is without foundation in every particular.*

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[1] H. AYERS, *Journal of Morphology*, vol. vi., No. 1, 1892.

[2] SHAMBAUGH, "Restudy of the Minute Anatomy," etc., *American Journal of Anatomy*, vol. vii., No. 2, p. 245, Aug., 1907.

SARCOMA OF THE MIDDLE EAR.

By ALEXANDER ZEBROWSKI, M.D.

THE malignant tumors of the middle ear are observed on the whole very rarely. The number of the middle-ear sarcomata described is less than fifty; the number of the sarcomata which developed in any part of the organ of hearing is less than 100, although this malignant tumor can develop in all parts of the ear, in the concha, in the external ear canal, in the drum-cavity, in the mastoid, and at last in the labyrinth and auditory nerve. In consideration of the rarity of this disease I will describe a case of sarcoma of the middle ear, which is remarkable in many instances. This case I observed and operated upon in 1905, in the ear department of the military Ujardow Hospital, in Warsaw.

The literature of this subject until 1896 is to be found in an excellent monograph by P. Asch,[1] who gathered all cases published up to this time and added three cases of his own of the middle-ear sarcoma. The statistics of P. Asch in regard to the frequency of the separate parts of the ear affected are as follows:

Sarcoma of the concha	10	cases.	
" " " external Canal	3	"	
" " " middle ear	50	"	(about).
" " " labyrinth	20	"	(about).

1 " Das Sarkom des Ohres." Inaugural Dissertation der medicinischen Fakultät der Universität, Strassburg, von Paul Asch, 1896.

In the accessible otological literature from 1896 I have found only three cases of middle-ear sarcoma. They are two cases of W. MILLIGAN[1] (both females, 36 and 18 years of age), and one case described by DR. E. OPPIKOFER[2] (a child, 8 years old). All these cases were operated upon with fatal results.

Description of the Case.

I. N., soldier, 25 years of age, native of Poland, a tall, very anæmic and apathetic man. The apathy and the pale color of the skin are striking. The internal organs are normal. Pulse 92, temperature 38° F. The tones of the heart are feeble but pure, profuse, purulent bad smelling discharge from the left ear. The left auditory canal is filled with a growth, which bleeds on touching with a probe. It is impossible to find the place, where the growth springs from, because its base occupies nearly all the drum cavity. In the left mastoid region is a tumor about the size of a hen's egg, tender on pressure, which goes down the neck to the *cartilago thyreoidea*. In this place, on the neck is a small wound (5 *cm* in length, 3*cm* in breadth) is to be seen, covered with reddish soft granulations. *Total palsy of the left facial nerve.* In the nasopharynx is a large quantity of adenoid vegetations (?), which are exceptionally soft and bleed on touching with the finger, the voice and respiration are, however, without alteration. The right ear is normal. In the left ear the hearing is diminished (whisper by the ear), Rinne−, Weber+.

The patient remarked that the tumor had been growing about eight months, but he cannot tell exactly when the palsy of the facial nerve first appeared, how long he had had the purulent discharge from the left ear, or what happened earlier—in short, it is impossible to collect any definite history. Two months ago, because of a "boil" on the left

[1] "Zwei Fälle von Sarkom des Mittelohres." W. MILLIGAN.—*Zeitschrift für Ohrenheilkunde* B. 30, p. 226.

[2] DR. E. OPPIKOFER. "Annual Report of the Oto-laryngological Clinic and Polyclinic in Basel: Sarcoma of the Right Middle Ear, involving the Labyrinth and Both Cranial Fossæ. Operation. Death," ARCHIVES OF OTOLOGY 1905, p. 291.

side of the neck, he was operated upon by the field-surgeon, who made an incision in the "boil," but found no pus.

On August 14, 1905, I performed, under chloroform anæsthesia, the following operation. At first I removed the growth in the left drum cavity. After removing the growth the drum cavity was examined and total absence of the drum membrane and both ossicles was noticed. The drum cavity was filled with granulations, which were carefully removed with a small sharp spoon. Then an incision was made over the mastoid from the temporal line to the wound on the neck. A large cavity was found extending from the tip of the mastoid, ***angulus mandibulæ*** to the *processus transversus atlantis* which was filled with soft gray masses, which were easily removed with the spoon and with the finger. The *fascia colli profunda processus transversus atlantis* and ***angulus mandibulæ*** were to be seen as in anatomical preparation. By separating of the concha it was noticed that the concha was almost totally separated from the temporal bone by the destructive process and that the posterior upper part of the external ear canal was also destroyed. Because of these pathological alterations the performance of the radical operation was relatively easy. The mastoidectomy showed that some cells of the mastoid and the antrum were filled with soft granulations similar to the growth in the drum cavity, over the mastoid, and in the neck. The masses of the tumor did not pass into the skull cavity; the ***lamina vitrea*** was not involved, therefore I did not open the skull. After removing all pathological parts and after performing the radical operation, the large wound in the neck and in the mastoid region was filled with iodoform gauze and the usual dressings were applied.

August 15, 1905. The general condition of the patient was much better. The tenderness on the left side of the neck had disappeared. Temperature 36.8° pulse 80, change of the dressing shows that the wound is clean, no pus. The dressing is made every day and after a week I observed that the regeneration of the tumor had already begun, at first in the form of the small feeble granulations, which increased very quickly. At the same time on the left shin bone I perceived under the skin a tumor as large as a pigeon's egg. I removed this without difficulty under cocain-anæsthesia and

examined it under the microscope, together with the growths in the drum cavity, in the neck, and in the antrum. The examination showed the absolute identity of all these parts of the tumor—it was a *sarcoma globocellulare.* All these tumors have just the same microscopical structure. Very large quantity of the round cells and small quantity of binding tissue. In the following course of the disease, the tumor increased very rapidly in the neck and in the drum cavity, which after several weeks was again totally filled with the growth. The temperature was normal only during the first six days after operation—the following post-operative course of the disease was with a high fever (38.8°–39.3°) and a pulse continually more than 100. Daily dressings were applied. The patient was always apathetic and for some days before death complained of headache. Death occurred suddenly seven weeks after operation, when the patient was sitting on his bed early in the morning.

Post-Mortem (extraction from the section record). All lymphatic glands on the left side of the neck and three glands on the right side are enlarged, soft, of grayish color. The nasopharynx is filled up with the same growth. The tumor had destroyed part of the sphenoid bone and joints of the occipital bone. The *processus odontoideus* had entered into the skull cavity and had destroyed the medulla. Œdema of the brain. In the right lung, four metastases of the tumor, each about the size of a pea. In the muscle of the left ventricle of the heart one metastasis 5*cm* long and 5*cm* broad and 2*cm* thick. In the pericardium about 1000*cc* of reddish, muddy fluid. Dilatation of the heart. The postoperative wound in the neck from the radical operation is filled up with the soft reddish granulations. The *malleus* and *incus* are not present. The facial nerve in the bone is surrounded with the granulations but the canal of the seventh nerve is not opened. Labyrinth macroscopically is normal.

Diagnosis anatomica: Lymphosarcoma colli, ossis temporalis et corporis ossis sphenoidalis cum metastasis in pulmone sinistro et in corde. Pericarditis seroso-fibrinata. Destructio medullæ oblongatæ per processum odontoideum vertebræ secundæ.

The clinical course and the result of the section in my case suggest many critical remarks, concerning the etiology, diagnosis, and operative treatment of the middle-ear sarcoma. In regard to the absolutely obscure question of the etiology of the malignant tumors in general, the primary cause, which produces the malignant growth in the ear is still unknown. ASCH, in his dissertation endeavors to find the causal connection between the jellied mass, which is to be found in the middle ear of the new-born and the relatively often appearance of the myxosarcoma of the middle ear in childhood; the small number of the cases does not allow any positive conclusion to be made in this direction. Moreover, HÖLTSCH had demonstrated that in the drum cavity of the new-born there is no jellied mass, but a thickened mucous membrane. The purulent discharge from the ear, which occurs without exception in all cases of cancer of the middle ear was given as an etiological agent of the malignant tumors of the middle ear. STURM,[1] after describing a case of a primary cancer of the temporal bone with suppuration in the drum cavity of many years' standing brings us to the analogy between the forming of the cancer in the fistula of the long bones (for instance shin bone) and in the temporal one. The chronic suppuration of the middle ear, when the drum membrane is perforated near its margin ("randständige perforation") evokes the growing of the epidermis into the drum cavity and its metaplasia, hence the origin of the flat epithelial cancer in the middle ear, although in the drum cavity the flat epithelium is not present. With regard to the sarcoma, it seems that the precedent suppuration from the ear is not a necessary condition for the appearance of the tumor. HARTMANN[2] had observed

[1] STURM, "Zur Kenntniss des primären Plattenepithelkrebses im Schläfenbein," *Zeitschrift f. Ohrenheilkunde*, vol. 40, p. 276.

[2] ARTHUR HARTMANN, "Ein Fall von Ründsellen Sarkom von der Trommelhöhle," *Zeitschrift f. Ohrenheilkunde*, vol. 8, page 213.

a case of middle-ear sarcoma in a child, three years of age, without purulent discharge from the ear. For the most part, however, in the cases of middle-ear sarcoma the suppuration from the ear had been noticed (CHRISTIANECK, MILLIGAN, ASCH, *A. f. O.*). In my case it is impossible to determine if the purulent discharge had existed before the appearance of the tumor or was produced by it. At any rate the suppuration from the ear must be taken as an agent which favors the production of the malignant tumors and therefore must be carefully cured: that is the sole prophylactic measure which can be used against the malignant tumors of the ear.

The large destruction of the skull bones and the malignant degeneration of the lymphatic glands in the nasopharynx and in the neck, in my case, makes it doubtful whether it was a primary sarcoma of the middle ear, or perhaps a secondary or metastatic tumor. The early palsy of the facial nerve is a characteristic symptom of a primary sarcoma of the middle ear. ASCH affirms after consulting a relatively large number of cases from the literature, that in the differential diagnosis between primary and secondary sarcoma of the middle ear the facial palsy is of great importance because it occurs only in the cases of primary middle-ear sarcoma.[1] The microscopic examination of the growth in the drum and antrum cavities which had shown that it was a sarcoma speaks also for the primary origin of the tumor in the middle ear.

The diagnosis of the primary or secondary sarcoma of the middle ear is difficult. In absence of the facial palsy, and of the tumor in the mastoid region the idea of such a hopeless disease will arise when all of these other symptoms are present. Only the microscopical

[1] "Bei der Differenz von primären und sekundären Sarkom wird man, sofern Zweifel bestehen sollten, an das Fehlen der für das erstere so charakteristichen Facialislähmung bei dem sekundären Sarkom denken,"—ASCH, p. 59.

examination of the granulations in the drum cavity, which after removing grow afresh in a short time, can clear up the question. The cases from literature demonstrate that the sarcoma of the middle ear can appear as a complication of another also grave and dangerous disease, for instance, of a cholesteatoma of the ear (second case by W. MILLIGAN) and is not recognized early. In short till the present day we don't know the cases of the middle-ear sarcoma which were diagnosed sufficiently early for the favorable result of operative treatment. It is evident, that if the tumor had destroyed nearly a half of the skull, every rational operative treatment is impossible. Even the most extensive radical operation with removal of all pathological parts is only palliative; this operation in my opinion must be, however, performed in all cases of the middle-ear sarcoma, for it is the *ultimum refugium* and it is not impossible under favorable conditions to secure even many years without regeneration. ALEXANDER[1] in the last article describes nearly total resection of the temporal bone. If the technical performance of this operation can be improved perhaps the malignant tumors of the middle ear will be accessible for operative treatment as are the malignant tumors of the larynx.

In a manner the immediate cause of death in my case is interesting. This cause was the falling of the *processus odontoideus* into the skull cavity and destruction of the medulla the death occurred suddenly. This at all events unusual phenomenon was made possible through an extensive destruction of the articulations of the occipital bone. Usually the death occurs as a consequence of marasmus (cachexia) which develops very rapidly, even more rapidly than in the cancer of the middle ear.

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[1] *Monatsschr. f. Ohrenheilkunde*, vol. 41, p. 344.

A CASE OF LARGE CHOLESTEATOMA OF THE MIDDLE EAR AND THE POSTERIOR CRANIAL FOSSA, CURED BY RADICAL OPERATION. NO RECURRENCE AFTER EIGHT AND ONE-HALF YEARS.

By C. ZIMMERMANN, M.D., Milwaukee, Wis.

(Demonstrated before the Medical Society of Milwaukee County, March 8, 1907.)

ON the patient I am going to present to you this evening, I performed the radical operation for cholesteatoma of the middle ear and the posterior cranial fossa eight and one-half years ago. Ever since he has enjoyed perfect health and has been able to devote himself uninterruptedly to his work as a farmer. He visited me this morning, and I am glad to have the opportunity to show him to you, as his case demonstrates a perfect and lasting cure of cholesteatoma which, according to experience, can only be considered safe after a long time.

With regard to the nature of the disease, I ask your permission to quote from my paper, in Archives of Otology, vol. xxix., No. 4, 1900, p. 290, and from recent literature. Cholesteatoma of the ear is a globular tumor of the size from a grain to that of a hen's egg, of bluish-white or yellowish color, and a lustre like mother-of-pearl. Its cortex shows the structure of epidermis, and its substance consists of products of the latter, *viz.*, cornified scales, which form concentric lamellæ, like an onion. The central portions frequently contain cheesy detritus from

decaying epithelia and thickened pus, and between the lamellæ are found crystals of cholesterine, fat granules, and micro-organisms, sometimes giant cells. Its seat of predilection is the middle ear, chiefly the attic, aditus ad antrum, and the mastoid process.

There is some discrepancy of opinion as to the origin of the disease. Most pathologists identify cholesteatoma of the ear with that of the pia mater and cranial bones, which are considered as regular heteroplastic new-formations, developing, at the time of the separation of the medullary tube (Bostroem), from displaced embryonic cells like dermoids or atheromata (Mikulicz), or from detachments of epidermis of the first branchial arch (Kuester). Although the epidermoidal character of cholesteatoma had been assumed by Remak, Billroth, Ziegler, Mikulicz, Ponfick, Ribbert, and others, the strict proof for it was furnished by Bostroem in 1897, who proposed the term "epidermoid" for cholesteatoma. His investigations showed that the lining of the cholesteatomatous sac consisted of all the characteristics of epidermis, *i.e.*, in typical succession, of layers of basal cells, of granules, and a corneal stratum and eleidin granules peculiar only to epidermis. According to Scholz, who verified this condition in two cases from the pathological institute of Ponfick at Breslau (*Virchow's Arch.*, vol. clxxxiv., p. 255, 1906), the assertion of Borst, Dürck, De Stella, and others, that cholesteatoma was of endothelial origin, has not been proved so far. On the contrary, in several cases (Beneke, Scholz) which had been described as endothelial formations (developing from the endothelium of the meninges or ventricles), careful controlling after-examinations revealed these as epidermoidal tumors. Scholz also shows the fallacy of those who assume a metaplasia of mesodermal elements, *viz.*, endothelia, into epithelia as being against the law that a metaplasia only takes place between histogenetically identical tissues (Ribbert).

Some otologists, *e.g.*, v. Törlsch, Schwartze, Panse, Grunert, and others, however, find this kind, the primary cholesteatoma of the ear, to be extremely rare, and consider the occurrence of cholesteatoma in the ear as secondary to chronic purulent otitis, which is always present in cholesteatoma, and caused by a conversion of cylindrical epithelium into pavement epithelium, or, most frequently, by an immigration of epidermis, and therefore call it pseudo-cholesteatoma, otitis desquamativa. Habermann observed clinically and proved histologically the continuous growing of epidermis of the external meatus into the middle ear through perforations of the *Mt* or meatus. Schwartze in his historical remarks on cholesteatoma of the temporal bone (*Archiv f. Ohrenheilk.*, vol. liv., 1901, p. 139) says: "Through Habermann the growing of epidermis into the middle ear is now proved as cause of the formation of cholesteatoma dependent upon certain anatomical conditions and thus the development of cholesteatoma on the pathological lining of the middle ear for many, perhaps the great majority of cases, explained in a plausible manner. Only for a small portion of them, in which a tumor is found in the middle ear without preceding suppuration and without the possibility of epidermis growing in from the external meatus, we need for the explanation of the genesis of the tumor, which then must be considered as heterologous, the assumption, first made by Buhl, of a congenital foundation, *viz.*, a separation of pavement epithelium in the embryonic period of development." According to the most favored seat of cholesteatoma in the attic, this process chiefly takes place through perforation of Shrapnell's membrane above the *Mt* proper, but the same has been observed at other portions of the *Mt*. Apparently after long-standing suppurations the cylindrical epithelium loses its faculty of regeneration, so that the epidermis, which is very resistant against the destructive influence of pus, spreads readily to places

formerly covered by cylindrical epithelium. This alone, however, would not lead to the formation of cholesteatoma since we observe such an epidermization as the result of permanent healing of purulent otitis media with large defects of the *Mt*, and therefore consider its development as very desirable. There must be some other reason for the formation of cholesteatoma which lies in an impediment of disposing of the cornified epithelium, and in an increased production of it. Panse (*Haug's Klin. Vortr.*, vol. ii., p. 4) observed a slow migration of cast-off epithelial scales from the tympanic cavity of a patient on whom the radical operation had been performed, and he attributes this, as well as the excretion of scales and cerumen from the normal ear, first, to the movements of the lower jaw in mastication and, secondly, to the existence of a free passage. If, owing to peculiar anatomical conditions, the anterior wall of the meatus cannot be influenced by these movements, we have a predisposition to the formation of ceruminal plugs in the normal ear, or, if after preceding inflammations bands have developed which produce recesses and obstruct the passage, an accumulation of epithelial cells will result. The proliferation of epithelial cells is caused by inflammation, in consequence of irritations that reach the ear from outside, as water, instillations, etc., or the persistence of chronic suppurations in other portions of the tympanic cavity. The epidermic masses become imbibed with fluid, swell, and decay to very offensive material, and create inflammations of the surrounding tissues, periosteum, and bones, leading to caries and osteosclerosis. Even the accumulation of cornified cells alone is sufficient to destroy the bones by pressure, like an aneurysm. This is characteristic of cholesteatoma, and is caused by interference with the nutrition of the bone in consequence of compression and thrombosis of the vessels of the Haversian canals. Thus the recesses of the middle ear may be converted into one

large cavity, and the dura mater exposed to a great extent.

Kuhn, Koerner, Kümmel, and others, however, maintain that this view, that almost all cholesteatomata of the ear be due to an immigration of epidermis is not a warranted generalization, and is in sharp contrast with frequent operative findings, especially in children, which disclosed immense cholesteatomata after ear suppurations of such brief duration, that their development from immigration and proliferation of epidermis appears impossible. Koerner found that the least number of cases of epidermic immigration produce masses in the form of tumors like real cholesteatoma.

Cholesteatoma is a chronic disease which may last for many years without disturbing the general health of the patient. It is a complication of chronic otorrhœa in a proportion of 1:5 (Bezold). Schwartze (*Chirurg. Krankh. des Ohres*, p. 225) found that cholesteatoma occurred frequently in tuberculous and scrofulous individuals. Konietzko (*A. f. O.*, vol. lix., 1903, p. 206) says that a diseased base of epidermis grown in the middle ear is a *conditio sine qua non* for the formation of cholesteatoma. He reports a case from Schwartze's clinic in which a proliferation of epidermis had taken place over a tuberculous mucous membrane of the middle ear. This is emphasized, as Scheibe asserted that in tuberculous processes of the middle ear cholesteatoma as a rule does not form. Bōke (*A. f. O.*, vol. lviii., 1903, p. 228) attributes the development of cholesteatoma to tubercle bacilli in a case in which the microscope revealed crystals of margarin and cholesterine, pavement epithelium, partly preserved, partly detritus, fat cells and cell rudiments, tubercle bacilli in the cheesy mass and in the pus of the fistula. This mass yielded cultures of bacillus lactis aërogenes, staphylococcus pyogenes aureus, and proteus vulgaris. He also found tubercle bacilli in another case. Koerner (page 111) saw immigration of

epidermis most frequently after scarlet otitis, never in tuberculous suppurations of the ear.

The *diagnosis* is made from the presence of stratified epithelium in the middle ear, which may be brought forward with the tympanic syringe or with the probe. But very often the distinction between true cholesteatoma and pseudo-cholesteatoma is hardly possible. Koerner enumerates eight points of anatomical and clinical characteristics for the differential diagnosis between both affections, but says that the cases not clear in their genesis, generally differ in their clinical aspects much more markedly from the immigration of epidermis than from true cholesteatoma. Therefore they so far must be considered and treated as true cholesteatomata (*Die eitrigen Erkrankungen des Schläfenbeins*, Wiesbaden, Bergmann, 1899, p. 110).

If left to itself, the *prognosis* is very serious on account of cerebral complications, which will result from the progressive wasting of the bone. As pointed out by Scholz, the epidermoids of the brain (which are always in connection with the pia mater, and of which two-thirds are situated at the base or close to it), are by themselves benign tumors, but, on account of their inaccessible seat and the impossibility of early diagnosis from lack of definite symptoms, they may not be operable and then become fatal. Then the tumor itself is not the cause of death, but the subsequent acute hydrocephalus, as shown by a case of Hirtz (*Bulletins de la société anatomique de Paris*, 1875, p. 254), in which a cholesteatoma of the size of a hen's egg had totally compressed the vena magna Galeni. Likewise may the absence of external signs of inflammation in cholesteatoma of the ear hide immense destructions going on within the mastoid process and the neighboring cranial cavities and thus procrastinate timely operative interference. Ephraim (*A. f. O.*, 1902, vol. liv., p. 244) observed after operations for cholesteatoma new formations of yellowish white

lamellæ in the cavities and after their removal the underlying layer reddened, and considers the malignancy of cholesteatoma dne to its tendency to local destruction, not to its general influence on the organism. This however seems gradually to disappear as the inflammatory formative irritation ceases with the removal of pyogenic material. According to Kümmel (*Handbuch der prakt. Chirurgie von v. Bergmann & v. Bruns*, 3. *Aufl.*, 1907, p. 388), the prognosis of both affections (true and pseudo-cholesteatoma) is different. The extensive destructions of the bones by a true cholesteatoma lay open the cranial cavities to a large extent and, if an inflammatory process finds its way through them, lead indirectly to an intracranial complication. A large number of the observed affections of the brain and sinus after otitis is due to cholesteatoma. The desquamative otitis is, by the ulcerations of the bone very regularly accompanying it, occasionally followed by such complications, but more rarely than true cholesteatoma.

The *treatment* consists in removing the cholesteatomatous masses, and in healing the purulent otitis media. This may be done from the meatus, if the cavity is only small and can be inspected. If not, the whole middle ear and mastoid have to be opened, so that the cavity can be examined all over and thoroughly cleansed. The operation is only the commencement of the treatment. The changes of dressing are of paramount importance for procuring epidermization of the cavities. The developing granulations have to be dealt with in the proper way by tamponade and, if necessary, by cauterization. As soon as the antrum is covered with epidermis, the postauricular opening may be allowed to close, so that finally the whole cavity is nothing but an extended ear canal. Some operators close the external wound primarily. If, however, the cholesteatoma and the cavity, remaining after the operation, are very large, it is sometimes not possible to close the postauricular opening, as

in a case I saw in the clinic of Dr. Lermoyez at Paris, where almost one whole side of the head was occupied by the cavity, or, since cholesteatoma has a great tendency to relapses, it may not be advisable, so that the cavities remain open for inspection, and can be kept clean, which *e.g.*, in our case could not have been sufficiently accomplished from the entrance of the ear.

This *course of treatment* has been adopted in this case of a man, now aged 36 years. He came to me March 30, 1897, and presented the following condition:

Left ear: Very large masses of polypi projecting from external meatus. Offensive discharge; extensive necrosis of middle ear. Removal of polypi, scraping and cauterization of the diseased walls.

Right ear: A large polypus springs from the posterior wall of the tympanic cavity. Attic filled with offensive cholesteatomatous matter, which was removed. After-treatment until July, 1897.

October 28, 1898, he returned, very much emaciated, with the history that about a month ago an abscess had formed on right side of neck. A fistulous scar, one inch in length, commencing one and a half inches below the tip of mastoid, ran down along the sterno-cleido-mastoid muscle (Bezold's mastoiditis).

Total paralysis of right facial nerve. Offensive discharge from right ear. Posterior wall of meatus bulged forward, flabby, and covered carious bone. Some cholesteatomatous masses evacuated with probe.

Left ear showed a new formed *Mt*, with perforation through which a small polypus projected which was taken away. November 1, 1898, radical operation. After removing the external surface, the whole mastoid process presented itself transformed into a large cavity filled with an offensive, very large, cholesteatoma up to the lateral sinus and the dura mater. All the *cavities of the middle ear and the posterior cranial fossa were widely opened and thoroughly scraped.* A perforation of the medial aspect of the tip of the mastoid process led into a fistula which ran downward to the fistula on the neck. The tip was chiselled away and the

fistula scraped. The medial portion of the posterior wall of the meatus formed a loose sequester, which presented a semicanal, apparently the lateral portion of the Fallopian canal. The dura was largely exposed and thickened. No granulations ever developed on it; it practically exhibited the same smooth surface during the whole treatment as it shows now. The rest of the wound is covered with epidermis and scar tissue.

The patient recovered very well, and his hearing is better than before. The facial paralysis is partially cured, the patient can close his right eye completely, only the folds of the face on that side are not as deep as on the other. The right angle of mouth hangs lower than the other, and the patient is unable to whistle. The after-treatment, up to complete epidermization, lasted six months. When last seen, on December 7, 1899, everything had remained well.

The present condition is this: Postauricular external opening oval shaped, vertex downward, 2.75*cm* long, 1.5*cm* wide at the wider end. Wound covered with epidermis all over, excepting the dura mater. In the depth the dura mater is visible as a grayish membrane, and the sinus transversus, blue, shows distinct pulsations. The remainder of the petrous bone extends back to the frontal plane through the insertion of the concha. The greatest depth is 4*cm*. The posterior edge of the mastoid region projects over the cavity so that the inserted finger feels the dura about 2*cm* back of the overhanging wall.

The middle ear can be inspected from the posterior opening. It is perfectly dry and cicatrized and the attic very much enlarged, covered only in its posterior portion by skin of the meatus. The patient hears loud voice at two feet. The concha droops a little downward and forward, obstructing thereby the meatus, by bringing its posterior wall in contact with the anterior wall, which probably was caused by his crowding too much cotton into the postauricular opening. His hearing is improved when, by pulling the concha backward and upward, the meatus is made entirely free. The left ear shows perfect cicatrization of the tympanic cavity and attic, which is perfectly free. He hears loud voice at one foot but hears better with the other ear.

REPORT OF THE TRANSACTIONS OF THE NEW YORK OTOLOGICAL SOCIETY.

THOMAS J. HARRIS, M.D., SECRETARY.

MEETING OF JANUARY 28, 1908. THE PRESIDENT, DR. SHEPPARD, OCCUPIED THE CHAIR.

Dr. PHILLIPS presented a case of **epithelioma of the ear** with the following history. A woman, age forty, consulted her family physician about seven months ago for pain in the ear and a watery discharge. The auditory canal was swollen and, together with the continued pain, led him in September to do a mastoid operation. October 1st, when Dr. Phillips saw the case, the posterior wound had closed but the ear stood out in an unusual manner; there was necrosis of the floor of the canal; the pain persisted and the dischage was foul-smelling. He did a radical operation, finding the antrum had not been opened. A second operation was speedily required to remove the growth of granulation tissue. There immediately developed a new growth on the posterior lip of the mastoid wound. The microscopic examination showed a flat-celled epithelioma. At present she was under the X-ray and the pain was less.

The induration of the anterior flap was recent. It was his opinion that the mastoid had never been involved until after opening by her family physician, and that the subsequent operations had been made necessary as a result of the unwarranted interference.

Dr. DENCH spoke of a case of **epithelioma** springing from the orifice of the external auditory canal. He excised the entire auricle, and removed the enlarged cervical glands. A permanent cure followed. He had seen several cases of

epithelioma of the external ear, and in every case cure had followed complete excision of the growth. He would advise a complete removal of the growth in Dr. Phillips's case, and the subsequent treatment either by the X-ray or radium, if prompt healing did not take place.

Dr. DENCH also reported a case of **fibro-sarcoma of the middle ear** completely cured by radical operation, and also a case of **small-cell sarcoma, involving the middle ear and mastoid,** in which a mastoid operation was done, with subsequent ligation of the common carotid. The external wound healed, in a most thorough manner, under X-ray treatment. The malignant disease, however, extended to the lateral pharyngeal wall, and the patient subsequently died.

Dr. HASKIN spoke of a case of **epithelioma of the ear** which he had reported two years ago. Here he had done a series of extensive operations to extirpate the growth without avail. There had been, however, no meningeal symptoms.

Dr. WILSON stated that the case of **epithelioma of ear** reported by him, treated by the X-ray and radium combined, had remained well now for four years.

Dr. BERENS reported a case of **endothelioma of the auditory canal,** which he had recently operated upon. It originated from the membranous canal. An extensive fistula was found in the upper wall of the bony canal. He advised total excision of the growth in Dr. Phillips's case, and then using the X-ray.

Dr. ALDERTON thought the time elapsing after the primary operation before recurrence a variable one, and three years was too short to pronounce positively for a cure.

Dr. BERENS referred to a case of very extensive **mastoiditis** which he had seen recently. There was a perforation in the zygoma and a fistula extending to the occiput, where there was a subperiosteal abscess beneath the attachment of the trapezius muscle.

Dr. DENCH said he had seen one case of **mastoiditis with occipital fistula.**

Dr. GRUENING referred to a case of **double mastoiditis with perforation of the zygoma,** which he had recently reported.

Dr. LEWIS showed an **aseptic aural irrigating outfit.**

Dr. DENCH referred to the question of diagnosis of **sinus thrombosis in children,** as suggested in two cases lately seen by him.

CASE 1.—The patient was a child about two years of age. About one week before Dr. Dench saw the patient there was a follicular tonsillitis accompanied by a characteristic temperature. The tonsillitis disappeared, and the patient was allowed to go out. Three days later the patient complained of pain in the right ear, and there was a sudden rise in temperature. A myringotomy was performed by the family physician. As no discharge followed, myringotomy was performed again on the second day. When Dr. Dench first saw the case, there was a temperature of 104°, and both drum membranes were bulging. Double myringotomy was done, followed by free discharge. Both smears, after incision, showed latent streptococcus infection. The temperature remained high for twenty-four hours after incision of the drum membrane, and then fell slightly; forty-eight hours after the incision, the temperature was about 105°. Sinus thrombosis was suspected, but on the following day the temperature came down gradually, and was practically normal all day. It rose in the evening to 106°, at which time a double mastoid operation was performed, with the exposure of both lateral sinuses. Both sinuses were normal. There was extensive infiltration of both mastoids. The temperature fell immediately after the mastoid operation, and did not rise after that above 101½°. The child died suddenly, with symptoms of meninigtis, twenty-four hours after the mastoid operation. The first symptoms of meningitis were those referred to the circulation,—the heart being feeble, the extremities cold, and the pulse weak. A short time before this, both wounds were examined, and both lateral sinuses were found to be perfectly normal.

The second case was that of a child nineteen months of age who, a week before Dr. Dench saw the patient, seemed ill, did not take its food well, and was restless. The day before Dr. Dench saw her she was seen by the family physician. Negative report. When she was first seen by Dr. Dench the temperature was 105°. The child had been pulling at the ears as though in pain. Double otitis was present, and both

drum membranes were incised. Free discharge. The temperature fell considerably after the incision of the drum membranes, but 48 hours after, rose again to 104°. It then fell to nearly normal, but two days later rose to 106°. Both mastoids were opened and found to contain considerable pus and granulation tissue. Both lateral sinuses were exposed and seemed to be normal. The left sinus was larger than the right. The temperature after operation ranged between 101° and 102½° for about a week, and then rose to 104½°. Examination of the blood, at intervals, was negative. Neither sinus was opened. Frequent examinations of the chest were made, with negative results. The temperature gradually fell to normal, and the child made a perfect recovery. In this case, Dr. Dench was inclined to think that there was some slight systemic infection through the lateral sinus, probably due to the small tributary vessels which run from the mastoid to the sinus, and that Nature provided sufficient antitoxin to overcome the general septic condition. He pointed out that in quite a number of cases where the jugular has been excised for septic thrombosis, although the clot in the vein may be perfectly sterile, the walls of the vein are infiltrated with pathogenic bacteria. He would be inclined to think, therefore, that in this instance septic infection had taken place through the walls of the sinus, but that by prompt operation on the mastoid and free exposure of the sinus further absorption had been prevented. In this case as both mastoids were equally involved, had no exploratory operation upon the sinus been performed, it would have been necessary to open both sinuses, a procedure which, undoubtedly, would have proved fatal, from the great disturbance of the cerebral circulation. He believed that the patient's life was saved simply by delaying further interference.

Discussion.

Dr. DUEL called attention to the fact that sharp rises of temperature, and vacillating temperatures, occurring in infants and young children, could not be regarded in the same light as when they occurred in adults. He referred to a number of temperature charts from cases at the Babies Hospital, all of which had vacillations in temperature, which, in

adults, would be regarded as an indication of septic sinus thrombosis, with a concomitant suppurative otitis or mastoiditis. However, these charts in many instances resulted from mild cases of grippe, in which there was no otitis and very slight physical signs elsewhere were present. His attention had been called to the cases owing to these slight physical signs, and the possibility of the rises in temperature having been caused by an otitis media. On the other hand, a number of cases with quite similar vacillations in temperature had been due to the development of an otitis media, and had recovered after myringotomy without further complications. Had similar temperatures developed in an adult with an otitis or mastoiditis accompanying grippe, he would have felt it necessary to uncover and explore the lateral sinus. It seemed to him that these apparently septic temperatures, developing without middle-ear complications in cases of grippe and gastro-enteritis, made it difficult to decide the question of exploration of the sinus in cases where such vacillations appeared when middle-ear suppuration was present as a complication. He felt that other indications of sepsis, like large increase in the polynuclear percentage or presence of bacteria in a culture from the blood, would be necessary in many instances to justify such explorations.

Dr. GRUENING said that there had been very few cases in the Pedriatric wards at Mt. Sinai which had required operation, in his 27 years of service. In his experience children well taken care of did not need operation nearly as often as those that had been neglected.

Dr. DENCH thought a suppurating ear, with a septic temperature, if all other causes of temperature could be excluded, demanded an exposure of the sinus—possibly an exploration of this venous channel. Where the sinus is exposed, unless some definite evidence of thrombosis is present, Dr. Dench believed that the opening of the sinus might well be delayed for twelve hours. This was particularly true in cases of bilateral aural suppuration, in which the appearance of the sinus gave the operator no definite indication as to which sinus to open.

Dr. BERENS spoke of a child whose drum he had incised, where the irregulary high temperature persisted and yet

only a mild bronchitis could be discovered by the clinician. Two days later a central pneumonia developed clearing the situation.

Dr. BACON reported the case of a lady seen in consultation on account of a temperature fluctuating from normal to 105°. This continued for 10 days and then cleared up.

There was no trouble with the ear and although the patient was seen by a number of physicians who examined the case carefully, the cause of the high temperature was never ascertained. This case shows the importance of not laying two much stress on high temperature, especially in children.

Dr. ALDERTON reported the history of a case of **double otitis media,** following scarlet fever, resulting in double mastoiditis and leading to operation; complicated by albuminuria and acute endocarditis.

The patient was a boy twelve years of age, and was admitted to the Kingston Avenue Hospital on October 21, 1907. Examination at the time of admission showed a marked erythema and fine punctate eruption of the skin; eyes and ears, negative; nose showed considerable obstruction; tongue was red and throat congested, with two yellowish patches; heart was rapid and sounds clear.

October 22d: The patient was much more comfortable. Pulse was regular, of good volume and moderate tension; heart sounds clear, first sound at apex rather snappy; hemorrhagic area about body and right arm.

October 23d: General condition was considerably improved; rash losing its intensity; pulse full and strong; heart sounds clear. Nasal passages were not so much obstructed, but showed profuse discharge.

October 24th: The patient complained of the right ear. The tympanic membrane was congested and there was moist serum in the canal. When the drum was incised, some sanguinolent secretion escaped, but no pus. The general condition was improving, but there was great difficulty in swallowing, though the throat was clear.

October 25th: Loud systolic murmurs at apex of heart, not transmitted; considerable muco-purulent discharge from the right ear; slight mastoid tenderness.

October 26th: Patient was cyanosed as to face and ex-

tremities; systolic murmur at apex, first sound prolonged, second sound snapping; right wrist and knee joints painful to touch.

October 27th: Patient swallowed better and breathed more easily. No cyanosis; heart sounds clear. There was a slight systolic murmur at apex, with first sound prolonged, and a loud systolic murmur at the right sternal margin, transmitted downward and upward. The right knee and wrist, both ankles, and the shoulders were tender, with considerable swelling about the right knee and wrist. The general condition was improved.

October 28th: The patient took nourishment better and swallowed more easily. Loud systolic murmurs were noted at the apex, not transmitted. The inflamed and swollen joints were subsiding; joints moved without pain. The ears discharged slightly; both mastoids were tender on pressure.

November 5th: Operation was done for double mastoiditis; great destruction of bone was found, with exposure of the sinuses, which apparently were not involved. Following the operation, there was slight paralysis of the right side of the face; other than this, the patient went on to good recovery, and is practically well to-day, the paralysis of the face having disappeared. The main point in regard to this patient was the fact that the indications of probable sinus involvement were present preceding operation. He had a chill and the temperature shot up to 106°; following the operation the temperature rose as high as 105°, and yet, because of the condition of the patient, it was not thought advisable to investigate the sinuses. He made ultimately a good recovery.

Dr. ALDERTON said that occasionally malaria was the cause of the temperature in these obscure cases. He had seen such a case recently where quinine had stopped the fever and the patient completely recovered.

Dr. HASKIN called attention to the frequency in which intestinal infection was found in children suffering from ear trouble.

Dr. BACON reported a case of acute otitis media in a child where the temperature was due to pyelitis. The patient was an infant, female, six months of age, who had a grippe infection.

The drumheads were incised. An examination of the urine showed the presence of considerable pus. The patient made a good recovery. We often see cases of grippe in children commencing with an acute otitis media. After incising the drumheads the temperature frequently remains high and such children often have a bronchitis. The temperature frequently is due to a central pneumonia, the symptoms of which may not be evident for 3 or 4 days.

MEETING OF MARCH 24, 1908. THE PRESIDENT, DOCTOR JOHN E. SHEPPARD, PRESIDED.

Dr. BRYANT presented a case of **chronic middle ear suppuration,** mastoiditis, sinus and jugular thrombosis, gangrene of dura mater, basilar meningitis, pneumothorax, double pyothorax, radical mastoid operation, extensive exposure of dura over cerebellum, excision of jugular vein, section of sigmoid and lateral sinus, excision of rib. Temperature ranging between 105–106° and frequent chills for 8 weeks. Treated by operation and local antiseptics in an open out-of-door ward. Recovery. Hearing in operated ear, watch 6 inches, $\frac{6}{36}$

Dr. GRUENING reported the history of a **fatal case** of **mastoiditis** complicated by **thrombosis** of all the **sinuses** of the **head.** A boy was recently admitted to the hospital with symptoms of mastoid disease including a temperature of 106. There was a history of measles some time previous. For two weeks there had been an acute exacerbation of a chronic inflammation of the left ear, which had stopped at the time of admission. The pain which had ceased had recurred in the ear and there had been a chill. The neck was held very rigid and there was exquisite tenderness behind the sterno cleido-mastoid. There was a leucocytosis of 15,000 and a polynuclear count of 90%. The operation which was immediately performed showed a mastoid entirely destroyed, with exposure of the sinus which on being opened was found to contain pus. The vein was tied and excised and a return flow of blood established at the distal end of the sinus at a distance of about 1 inch from the torcular. The blood culture showed the presence of protens. There was a normal temperature at any time. There then developed an ecchymosis

of one eyelid soon followed by that of the other. The head became greatly swollen and disfigured. On the fifth day he became unconscious and died on the tenth day after the operation. The autopsy revealed a thrombosis of all the sinuses of the head, together with metastatic abscesses in the lungs. There was no optic neuritis which seemed to show in Dr. Gruening's opinion that optic neuritis was not due to the thrombosis of the sinuses alone but probably to thrombosis plus intracranial pressure.

Discussion.—Dr. KIPP said that for many years he had thought that optic neuritis was never found in an uncomplicated case of sinus thrombosis but recently he had seen several cases where such a condition was present and he now believed that this was to be explained by the unrecognized existence of a serous meningitis or œdema of the brain tissue.

Dr. MCKERNON reported a case of **Stacke operation** where the operation showed an almost complete bony obliteration of the tympanic cavity. The patient was a man of forty-one who had suffered from a suppuration from the middle ear for twenty-eight years and who had had over twenty aural operations through the external auditory canal. Examination showed that the lumen of the canal was occluded by a bony growth, above and anterior to which was considerable foul-smelling secretion. He complained of constant vertigo. There was no fever, and blood examination gave 16,000 leucocytosis and 62% polynuclear count. A radical operation was performed after forty-eight hours of observation. The cortex was found to be normal. The lateral sinus was, however, displaced very far forward and no antrum could be found. The middle ear was filled with a bony growth, there being in front only a cavity sufficient to admit the end of an applicator. The facial nerve lay exposed in the mass at least a quarter of an inch anterior to its usual position. A probe passed through the tegmen tympani to the dura evacuating an epidural collection of pus. This space was walled off by adhesions. The patient made a good recovery.

Discussion.—Dr. DENCH had seen this condition of bony growth in the middle ear in several cases but only in the beginning stage.

Dr. DENCH referred to the question of the **wisdom of**

removing granulation tissue in ambulatory patients and reported the case of a patient recently seen whom he had admitted to the hospital and had then removed the granulation tissue. The temperature which had previously been normal, at once went up to 104°. It later descended to normal but the patient had a chill and high temperature again. The radical operation which was then done revealed a clot in the sinus and in the vein. The vein was excised. There was a good recovery. This confirmed in his opinion his former statement that we were not justified in removing granulation tissue and then allowing our patient to go home. Indeed in most cases, a radical operation, was usually demanded where granulation tissue is present.

Discussion.—Dr. GRUENING did not agree with Dr. Dench and thought that in many cases local treatment if sufficiently long continued will cure the disease.

Dr. BACON said that it was often necessary to remove granulation in order to decide upon the advisability of a radical operation. He however agreed as to the wisdom of hospital supervision for such cases.

Dr. KIPP felt that Dr. Dench's position about hospital confinement in these cases was the proper course.

Dr. MCKERNON said that a number of years ago he had had a fatal case of meningitis following the removal of granulation tissue and was inclined to believe that the safest course was to open the ear from behind.

Dr. HARRIS reported a fatal case of **acute mastoiditis complicated by sinus thrombosis and meningitis.** The patient was a boy of ten who had just recovered from an attack of measles. When he first saw the case there had been a profuse suppuration from the affected ear for three days. There was no fever, no pain in the ear nor in the head. Examination showed no sagging of the superior wall, and no bulging of the drum. Deep pressure over the mastoid elicited no tenderness. The boy was at once ordered into the hospital. A smear from the ear pus showed pneumococci. There was a leucocytosis of 11,000 and a polynuclear count of 83%. In the absence of all mastoid symptoms it was determined to pursue an expectant course of treatment. Under hot irrigation and a wick carried down to the drum

the lad appeared to improve. He slept well at night and appeared bright in every way. There was, however, no cessation in the discharge and a blood examination on the fifth day after admission showed a leucocytosis of 16,000 and polynuclear of 87%. Dr. Harris accordingly determined to operate chiefly for the purpose of cutting the suppuration short. The mastoid was found very little diseased. There was considerable granulation in the antrum and the upper wall was quite soft. There was a small amount of pus in the antrum and in the tip cells. The operation lasted forty minutes. The only unusual fact to be noted was that the sinus was situated far forward and was exposed but not opened during the operation as it looked entirely normal. There was persistent vomiting following the operation but nothing else abnormal. The temperature, however, at once rose and twenty-four hours after the operation was 104 by rectum. The dressings were taken down and the wound found perfectly clean except at the tip where a drop of pus was seen beside the muscle suggesting the probability of a burrowing abscess in that locality. The fever did not go down but fluctuated from 102 to 104. There was no headache, no eye symptoms, and only a tenderness on touching the parts below the mastoid. There was obstinate constipation which was thought to account for some of the fever. On the fifth day after the operation, occipital headache and stiffness of the neck were noted. A lumbar puncture was made and showed a cloudy fluid with many leucocytes. A pure culture gave streptococci. An exploratory opening of the sinus revealed a firm, apparently healthy clot extending from the knee down into the bulb. A free flow was established from the torcular end but an unsatisfactory flow from the bulb. On account of the weakness of the patient and the evident presence of a meningitis it was determined not to tie the jugular vein at that time. The general sepsis was not checked by the operation. In the following day an incision was made into the brain but no excess of pressure on the membranes discovered. Death took place the same night. He remained conscious to the last. The case was very puzzling because of the absence of all mastoid symptoms as well as of any symptoms pointing to a beginning meningitis. It would be interesting to

know if the meningitis was direct from the ear or took place through the sinus. It is also of interest to know the way that the primary operation served to light up what had probably been a latent process.

Discussion.—Dr. PHILLIPS said that this case was particularly instructive to him, because it showed how an extensive meningitis could exist without any of the usual symptoms which are wont to be found in the disease.

Dr. BACON said that he recalled several cases of high temperature in children with sinus thrombosis. The classical up and down curve was entirely lacking.

Dr. DENCH reported a case of **plastic operation** to establish a normal canal after bony occlusion following an automobile accident. A fracture of the canal was discovered. There had been no discharge but loss of hearing. The operation restored the hearing to practically normal.

Dr. LEWIS reported two cases of **primary mastoiditis.** The first case was in a woman, æt. 45 with a neurotic history, who complained of a very slight pain in the ear and of a very moderate tenderness on deep pressure over the mastoid. This had continued for ten days previous to his seeing her. Examination showed but slight injection of the manubrial vessels, no bulging of the membrani tympani, and hearing but little diminished. He suggested a paracentesis of the membrana tympani which was done, and was followed by a slight serous exudate which ceased with the healing of the membrana tympani within twenty-four hours. Four or five days later tenderness over the mastoid process increased and the tissues were œdematous. He operated upon the case the next day, a cortical perforation was found, with considerable involvement of the cells.

The second case was seen at the Vanderbilt Clinic, the mastoid was extremely tender, the soft parts covering it œdematous with fluctuating at one point. There was no history of any discharge from the ear and the membrana tympani was normal in appearance. A cortical perforation was found when the mastoid process was opened and the cells were markedly involved.

Both were evidently cases of primary mastoiditis.

REPORT OF THE TRANSACTIONS OF THE CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

MEETING OF FEBRUARY 11, 1908. DR. A. H. ANDREWS, PRESIDENT.

Dr. WILSON read a paper on some points in the anatomy of the frontal sinus, which dealt chiefly with discussion of the floor of the frontal sinus, its relation to the nasal cavities, and the cribriform plate.

Dr. GOOD described an intranasal method for opening the frontal sinus. Dr. Good, after cocainizing the sinus by injecting 10% cocain, introduced into the sinus through the naso-frontal duct a small curved protector with the concavity anterior, then with a long narrow chisel part of the process frontalis of the superior maxillary bone, and a part of the spina frontalis of the frontal bone and the anterior median wall of the ethmoid labyrinth are chiselled through and removed with forceps and curettes. An instrument in the form of a rasp is introduced, and by directing the force of the rasp inwards and forwards a larger opening into the frontal sinus is obtained.

Dr. BECK has seen localized meningitis follow an intranasal operation done according to the Halle method. He calls attention to the inadequacy of intranasal operations when the sinus is divided by bony partitions. He thinks Dr. Wilson's method of locating the cribriform plate will be found of great value. He has attempted the same by means of the X-ray, but considers Dr. Wilson's measurements superior.

Dr. CORWIN is pleased with Dr. Good's demonstration, but

when the cavities and passages are filled with mucous membrane the use of the instruments will be more difficult, and adhesions which will interfere with perfect drainage will be likely to follow.

Dr. BALLENGER has found that in about one-half the cases the naso-frontal duct drains into the infundibulum and about one-half into the middle meatus as pointed out by Dr. Wilson. Accidents occurring during external operations are as frequent as those occurring in intranasal operations, the percentage in the former being greater when the radical operation is undertaken. He is impressed with Dr. Good's method and intends to try the operation. Serious results are not to be expected from removal of or injury to the inner table provided the dura is not opened. There is always more or less danger of hemorrhage from the anterior ethmoidal artery. Drainage is not the only consideration in these cases. If the cavity is thoroughly ventilated the infection will usually disappear even though the drainage is not perfect.

Dr. SHAMBAUGH thinks that in nearly all cases of acute disease of the frontal sinus intranasal operation will be found sufficient and in the chronic cases the external method should be employed only after the intranasal operation has failed. In many of the cases it is sufficient to remove the anterior end of the middle turbinate and the anterior ethmoid cells. This procedure frequently leaves the patient in better condition than the more radical intranasal operations. The rasp as shown by Dr. Good appeals to him as a good instrument for enlarging the opening into the sinus but when the opening is sufficiently large to admit the rasp drainage should be sufficient without having to use it. He exhibited a specimen in which the cribriform plate extended one-half inch anterior to the naso-frontal duct. In such cases a radical intranasal operation especially the use of a chisel would be likely to injure this structure. While the mere exposure of the dura in most localities is not associated with any great risk any injury to the cribriform plate is a much more serious matter. This plate is perforated by numerous nerve filaments and lymphatics which bring the dura into close relation with the nasal cavity. A mere fracture of the cribriform plate, even without a perforating wound, must result in considerable

laceration of these prolongations, and open the way for intracranial infection. Of the numerous intranasal methods for enlarging the opening of the frontal sinus he considers the method devised by Dr. Ingals as the safest yet suggested.

Dr. HOLINGER thinks it is not sufficient to provide for the escape of pus from the intranasal accessory cavities, but that they should be frequently cleansed by boric acid solution until the symptoms have disappeared. It must be remembered that the bony walls of these cavities are frequently diseased and that in operating the cranial cavity may be invaded even when only a probe is used. In the cases requiring operation there is more likely to be an abnormal arrangement of the opening than in normal skulls. The use of the rasp and curette is likely to be followed by the formation of granulation tissue which later will obstruct the drainage, while the cutting forceps does less violence to the tissues that remain.

Dr. ANDREWS sees some points in Dr. Good's method which are of value. He thinks greater accuracy is needed in the use of the terms "hiatus" and "infundibulum," and heartily commends the nomenclature as brought to the attention of the society by Dr. Wilson.

Dr. Wilson's determination of the location of the cribriform plate of the ethmoid is a most valuable contribution. He has never seen it described in the literature and thinks Dr. Wilson should be given full credit for establishing this rule.

Dr. WILSON (closing) has not been able to find any reference in the literature to locating the cribriform plate in relation to a line drawn from the nasal spine to the occipital protuberance. He favors draining the frontal sinus by the intranasal route, but thinks that before an operation is undertaken the relation of the naso-frontal duct to the cribriform plate should be ascertained. Exposing the dura seems to be harmless, but perforating the dura is dangerous, because the lymphatics lie not external to it, but in the arachnoid space, and this is continued down over the olfactory nerves as they pass into the nasal cavities.

Dr. GOOD (closing) does not consider exposing the dura as dangerous, but if it is perforated meningitis will be very

likely to result. The cribriform plate is not in the field of his operation, as he keeps external to it, passing upward at a tangent to the orbital wall. He does not recommend his operation for cases that can be cured by more conservative measures.

REPORT OF THE TRANSACTIONS OF THE SECTION ON OTOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

MEETING OF FEBRUARY 14, 1908. A. B. DUEL, M.D., CHAIRMAN.

Presentation of Instruments.

A NEW ELECTRIC MOTOR FOR CRANIAL SURGERY. By Wm. Sohier Bryant, M.D.

ELECTRIC LIGHT BULB. Presented by Dr. W. H. Haskin. Discussed by Drs. Wilson and Smyth.

Presentation of Patients.

CASE OF CARCINOMA SPRINGING FROM THE EXTERNAL CANAL. Presented by Emil Gruening, M.D. Discussion: Drs. Quinlan, Bryant, Johnson.

FOUR CASES OF OSSICULECTOMY. Presented by Dr. W. H. Haskin. Discussion: Drs. Gruening, Wilson, Bryant, Johnson, Kerrison, Duel, Haskin.

CASE OF OBJECTIVE TINNITUS DUE TO CONVULSIVE TIC OF THE TENSOR AND LEVATOR PALATI. Presented by Dr. G. B. McAuliffe. Discussion: Drs. Hinkle, Smyth, Quinlan, Bryant, Coburn, Cox.

Reports of Cases.

CASE OF MENINGITIS OF OTITIC ORIGIN. Operation; recovery. Dr. P. D. Kerrison. Discussion: Drs. Gruening, Quinlan, Kerrison.

CASE OF CEREBRAL ABSCESS WITH APHASIA. Dr. B. F. Knause. Discussion: Dr. Dougherty.

CASE OF MASTOIDITIS WITH INTERESTING FEATURES. Dr. A. B. Wiener.

Dr. Herman Knapp presented copies of the ARCHIVES OF OTOLOGY in both German and English.

A new electric motor for cranial surgery. Wm. Sohier Bryant, M.D.

Dr. W. SOHIER BRYANT presented this new instrument,